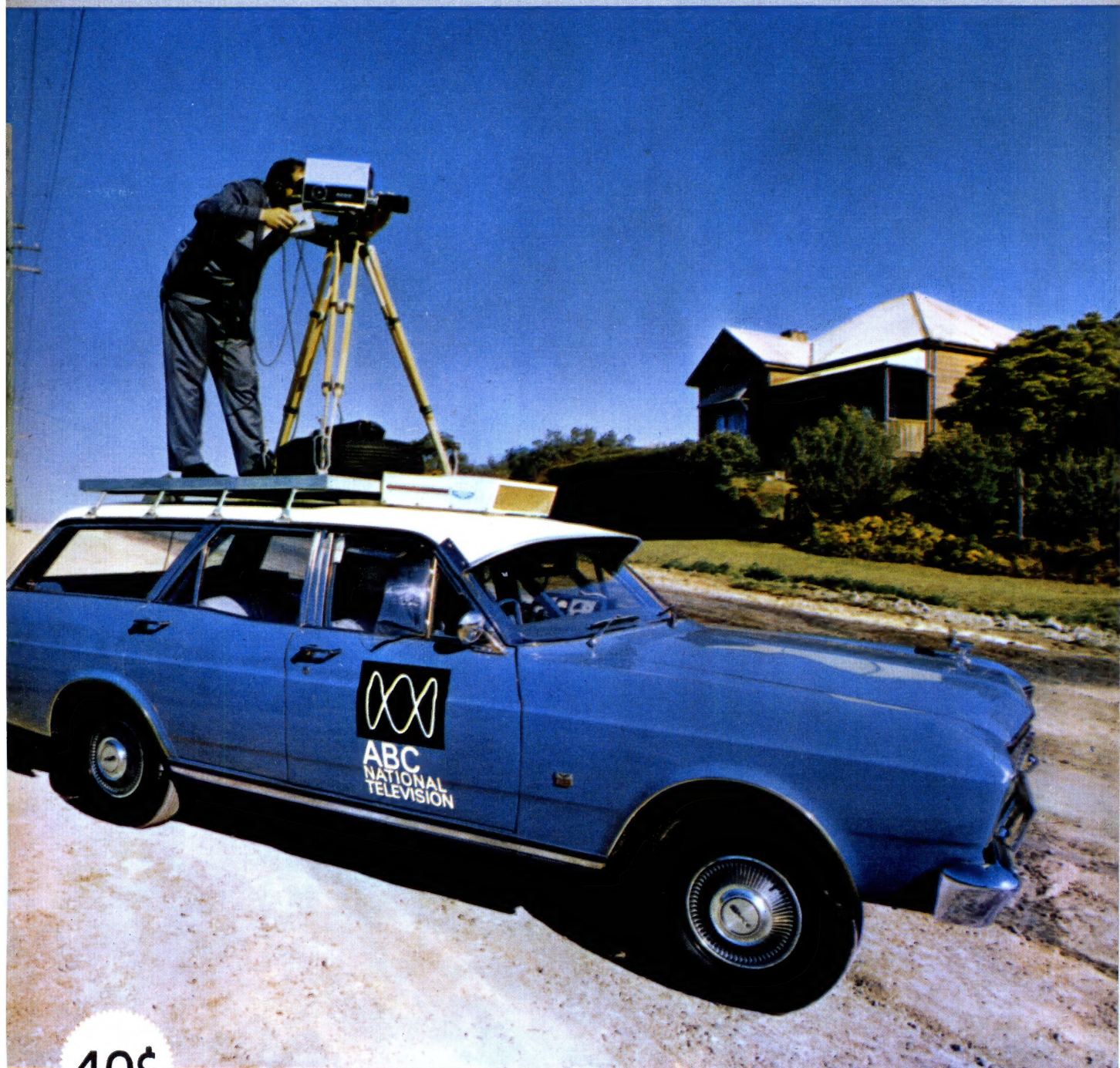


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Australia

May, 1970



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LOUDSPEAKER POWER RATINGS: *What do you do when you own a high-powered stereo amplifier but cannot afford high-powered loudspeakers to match its ratings? The article on page 112 discusses this very common problem.*

TAPE CASSETTES: *How do tape cassettes compare with discs in terms of content and quality? On page 121, Julian Russell reviews classical recordings recently released in cassette form.*

FREQUENCY METER: *This is a precision instrument which can take its place in any electronic laboratory. It will cost you much less than a commercial instrument. Page 40.*

1-WATT HANDSET: *Designed specifically for use on the amateur bands, this handset can be built for 52 or 144MHz, for either network operation or with a turntable receiver. Page 62.*

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Editorial Office:
12th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia.
Phone 2-0944.

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Box 2728, G.P.O., Sydney, 2001, Australia.

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Manager, Howard Jenkins
Sydney Representative, Bill Summons.
Office: 8th Floor, 235-243 Jones Street,
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Melbourne Representative, Clarrie Levy.
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Melbourne, 3000. Phone 67-8131.

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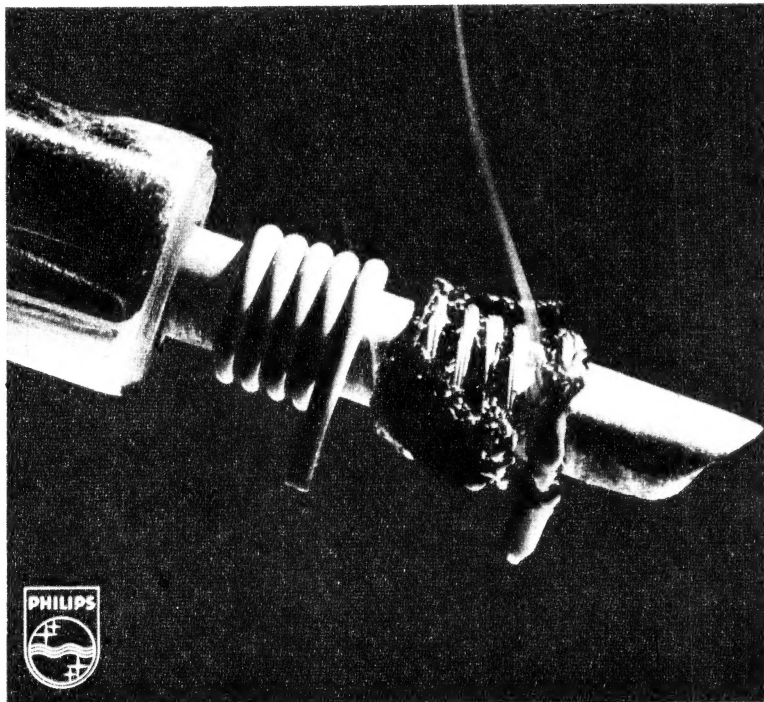
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EDITORIAL VIEWPOINT

by Neville Williams

Pirate radio

As we go to press, there are reports of a plan by two Sydney businessmen to operate a "pirate" radio station from a ship positioned off Sydney Heads, just outside the 3-mile limit. It is not at all clear what the sponsors could hope to gain from such a venture, since the residents of the Newcastle-Sydney-Wollongong complex have little in common with the pop-starved audience that earlier awaited pirate broadcasters off the coast of Britain and New Zealand.

However, if there is going to be one time more opportune than another for a pirate broadcaster to start up here, the present would possibly be it:

- There is a ship available, Tiri II. Radio Hauraki presumably has no further use for it, since becoming a respectable New Zealand commercial station.

- There are two or three disc jockeys around who would probably welcome the opportunity, once again, to grace the air waves with their presence.

- The record companies and the commercial stations, between them, seem to be well on the way to creating a potential "blackmarket" for a whole range of off-air pop sounds.

Australian regulations, gazetted in 1967, make it an offence to provide any kind of support or sustenance for a pirate radio venture, not only within Australian territory or territorial waters, but in waters "adjacent to Australia." In the face of such regulations, it would be very difficult for a pirate radio ship to remain functional, let alone to show any kind of a profit. By the time this issue actually gets into the hands of readers, it will probably be evident whether the sponsors of the scheme were serious or interested merely in gaining short-term publicity.

I imagine that the Australian broadcasting authorities will breathe a sigh of relief if nothing comes of the venture. Their relief will come from the knowledge that, on this occasion at least, the costs and embargoes will have proved an adequate deterrent for what would probably have been a commercial enterprise. If it were otherwise, the authorities in this country, as in most others, would have been hard put to it to deal with a broadcaster operating from the high seas with other motives.

I daresay that, if the problem of the offshore broadcaster became sufficiently widespread, action might be taken to add some international "teeth" to local regulations. At the moment the problem falls awkwardly in between: too local to provoke international intervention; too international for purely local control.

In the meantime, I.T.U. — the International Telecommunication Union — has more and bigger problems on its plate; problems which it would appear to be handling pretty well. We certainly wish it continued success. Otherwise, the possible invasion of national broadcast and television systems from satellite-borne transmitters would make the offshore broadcaster look a very trifling matter indeed.

On the cover

The A.B.C. regional station at Rockhampton has a new type of small video recording vehicle which allows more effective coverage of local news and other events. The unit carries a video tape recorder and camera channel for on-the-spot recordings which can be put to air within the hour. A similar vehicle is planned for the Townsville station. (See story page 14.)

EDITOR

Neville Williams
M.I.R.E.E. (Aust.)
(VK2XV)

ASSISTANT EDITOR

Philip Watson
A.M.I.R.E.E. (Aust.)
(VK2ZPW)

TECHNICAL EDITOR

Jamieson Rowe
B.A. (Sydney), B.Sc.
(Technology, N.S.W.)
M.I.R.E.E. (Aust.)
(VK2ZLO)

TECHNICAL STAFF

Ian Pogson (VK2AZN)
Harry Tyrer (VK2ZHH)
Alan Nutt (VK9AN)
John Horsfield
Robert Flynn
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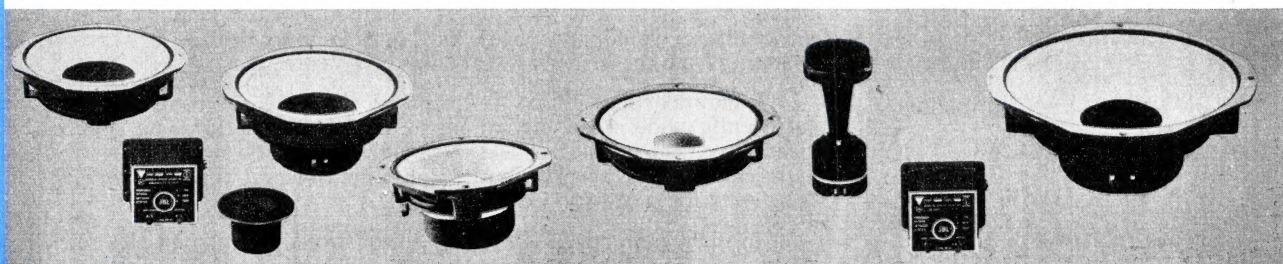
Impedance 8ohms.

CABINETS for JBL speaker systems are available in teak, maple or walnut finishes, and are both in kit form or built.

JBL LANCER 77 AND S11 SYSTEM

The LE10A LINEAR efficiency low frequency loudspeaker, with a 3 inch edgewound copper ribbon voice coil, lans-a-loys cone termination and a massive 10lb magnetic assembly, is normally combined with the LE20 high frequency transducer and the LX11 crossover network to make the S11 2 way speaker system. The S11 delivers smooth, full range performance and is ideally suited to our 2 cu. ft. enclosures. For more robust bass response the JBL PR10 "passive radiator" may be used in conjunction with this system in an airtight enclosure to effectively double the size of the speaker for greater dynamic range and smoother response well up into the mid-range. Frequency response 30-20,000 cps.

Impedance 8-16 ohms.



JBL S1 SYSTEM

Although the LE14A 14in Bass loudspeaker has an area equal to that of many 15in speakers it may be installed in an enclosure as small as 2 cu. ft.! The large 4 inch diameter copper ribbon voice coil and massive magnetic assembly (total weight 21lbs) enable this speaker to faithfully reproduce the lowest fundamentals, even at high power levels. The JBL LE175DLH driver/horn/lens assembly consists of a compression driver, cast aluminium exponential horn and 14 element acoustic lens for 90 deg. high frequency dispersion in circular symmetry. Transition between high and low frequency transducers is controlled electronically by the JBL LX10 with variable H.F. attenuator.

Frequency response 25-20,000cps.

Power handling capacity 60 watts RMS.

Impedance 8-16 ohms.

JBL LE8T, PR8 SYSTEM

The remarkable performance of the JBL LE8T in a 1 cu. ft. enclosure cannot be matched by any other single speaker ever produced! The LE8T boasts a 2 inch edgewound copper ribbon voice coil, lans-a-loys cone termination and a 6lb magnetic assembly. We now have available the C53 enclosure manufactured from JBL blue prints and measuring only 9in x 9in x 23in! The LE8T is ideally suited for mounting in walls or ceilings due to its shallow depth. For more prodigious base response the JBL PR8 passive radiator may be used to compliment the LE8T in airtight enclosures from 0.75 to 3 cu. ft.

Frequency response 30-18,000 cps.

Impedance 8 ohms.

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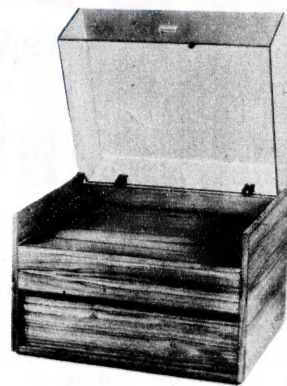
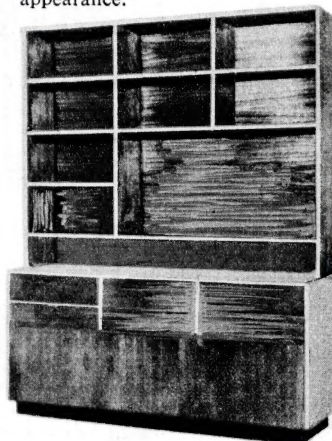
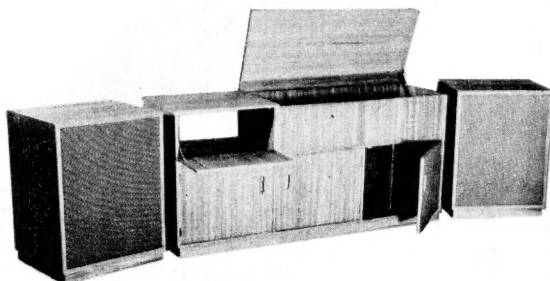
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DM78: Exceptional quality cardioid uni-directional dynamic microphone, for use in all stage and recordings, superb directional characteristics magnificently presented in its own black and red lined carrying case. Impedances: 50K and 600 Ω (switchable); Output Level: -75 db; Response: 30 CPS - 18 KCS; Cardioid (uni-directional); Weight: 13 ozs; Dimensions: 7 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ "; Case: Black abs plastic, with gold plated wire mesh black fly-off cradle with gold plated fittings. On/off switch. 20 ft lead. List Price: \$76.00.

NOTE

* 6 ft Florentine Bronze Floor stand with gold plated extension and locking height adj. available, for use with above model.

DM47: Highly efficient, cardioid, uni-directional dynamic microphone with excellent characteristics especially designed for all stage and recording use. Impedances 50K or 600 Ω or 50 Ω ; Output Level: -73db; Response: 40 CPS - 18 KCS; Cardioid (uni-directional); Dimensions: 5 $\frac{1}{2}$ " x 1 $\frac{3}{8}$ "; Weight: 18 ozs (incl. lead); Case: Black zinc diecast with chrome facings with on/off slide switch 20 ft lead; List Price: \$36.00.

DM67: Superb quality, cardioid uni-directional dynamic microphone, stable performance designed for stage and recordings. Impedances: 50K or 600 Ω or 50 Ω ; Output Level: -73db; Response: 40 CPS - 18 KCS; Cardioid (uni-directional); Dimensions: 5 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ "; Weight: 7 $\frac{1}{2}$ ozs; Case: Precision moulded, aluminite zinc diecast, with satin chrome facings. Fly-off cradle, 20 ft lead, on/off switch. List Price: \$33.00.



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read what the experts have to say about the GOLDRING LENCO GL75

PERCY WILSON

Manufactured by Goldring Manufacturing Company (GB) Ltd., 488-488 High Road, Leytonstone, London E11. Manufacturer's specifications: TURNTABLE: AC mains: 200/240 V, 50Hz. Mains switch fully click suppressed 4-pole constant velocity motor (15 VA). Continuously variable speed adjustment. Adjustable stops for 16, 33 1/3, 45 and 78 rpm. 9 lb. non-magnetic dynamically balanced turntable. Wow and flutter measured, according to DIN spec., 0.06%. Rumble measured, according to DIN spec., -60db. Speed variations $\pm 0.2\%$ for 10% mains voltage change. Automatic disengagement of idler wheel. Dimensions: front to back: 13in. Side to side: 15 in.

TRANSCRIPTION ARM: Pickup arm with counter-balance weight and bias compensation (anti-skating) adjustment. Knife-edge bearings. Stylus pressure adjustable from 0.5 to 5 grams, with sliding weight. Minimum stylus pressure 0.5 gram. Removable lightweight pickup headshell. Total length of pickup arm: 12.4 in. Tracking length (distance from pedestal to centre of turntable) 8.3 in. Overhang of stylus 0.675 in. Total adjustment for stylus position: 1/2 in. Offset angle: $23^\circ 12'$. Tracking error $\pm 0.8^\circ$. Can accommodate any cartridge. Hydraulic lowering device.

I have now had one of these transcription units on test for over six months; and some of my professional colleagues have made independent assessments which agree with mine. So, let me not beat about the bush, but declare my verdict straight away. This is, quite simply, that the GL75 is easily the best integrated turntable arm unit that the partnership between Goldring have yet produced.

This is, of course, a mouthful, for Goldring's products have long been known in the front rank. I have no hesitation in declaring that the GL75 is reckoned with in any company circumstances, anywhere in the world. Having made that confession, I must not merely of faith, I must justify it by stating the results of my tests. In this I shall not just describe the performance, but give you the facts that can be gleamed from the performance.

First of all, I must refer to the features. This is the continuous variation of turntable speed, which is a feature that perfectionists and others who know the perfect pitch, this is a feature that no other turntable I know of has. It is secured by having a drive wheel which travels along the turntable. This idler wheel is on a horizontal axis and its movement does not affect the motor. It is a simple and hasty and wrong design in which the idler wheel is at an angle to the turntable, and this is a design in which the idler wheel is at an angle to the turntable.

In my tests I mounted the motor plate on stilts as it were, above a rather thin motor board, which would resonate quite easily. I found the possibility of rumble all right, but I also found that the makers' recommendations had indicated the answer. In the first place, the motor plate must be mounted, as specified, on a motor board at least 3/4 inch thick. Do not on any account go below 3/4 inch. If the motor board in your cabinet is thinner than this, then stick a sheet of Celotex to it so as to damp out any natural resonance.

When suitable precautions are taken in mounting; such as the makers specify, the possibility of rumble is avoided. I have enlarged in this report on this possibility, because of the special vulnerability in a vertical drive as compared with a horizontal one; and to make it clear that the makers have safeguarded the position in their mounting instructions.

The second precaution to be taken, and this is vital, is that the motor should always be switched off and on at the switch on the motor plate and never at an independent switch. Otherwise the idler driving wheel would be left in contact with the turntable, and a tiny flat may be created on the rubber driving rim. In order to have accurate control of the turntable speed, this rim has to

Hi-Fi News, February, 1969. Frank Jones

MANUFACTURER'S SPECIFICATION.

Precision engineered transcription motor and arm. Turntable: Die-cast non-magnetic alloy dynamically balanced. Diameter: 12 1/2 in. Weight: 8.8 lb. Speeds: Infinitely variable between 30 and 88 r.p.m.; click-in stops for standard speeds including 16 2/3 r.p.m. Wow and flutter: 0.06% (DIN specification). Rumble: -60 db. Speed stability: Within 0.2% for a 10% change in mains voltage; within 0.3% for pickup playing at 5 gm. Lowering device: hydraulic.

PICKUP ARM: Lightweight type with decoupled counterweight and separate playing weight counterbalance. Stylus pressure: Infinitely variable between 0.5 gm, calibrated at 1 gm intervals. Total length: 12.4 in. Effective length: 8.3 in. Overhang: 0.675 in, adjustable up to 1 in. at the headshell. Offset angle: $23^\circ 12'$. Tracking error: $\pm 0.8^\circ$. Height: Adjustable. Dimensions: 15 x 13 x 2 1/2 in (above baseplate) x 3 in. (below). Weight: 18.7 lb.

GL75/P, on plinth with Perspex lid, as in photo.

Manufacturers: Goldring Manufacturing Co. Ltd., 488-488 High Road, London E11



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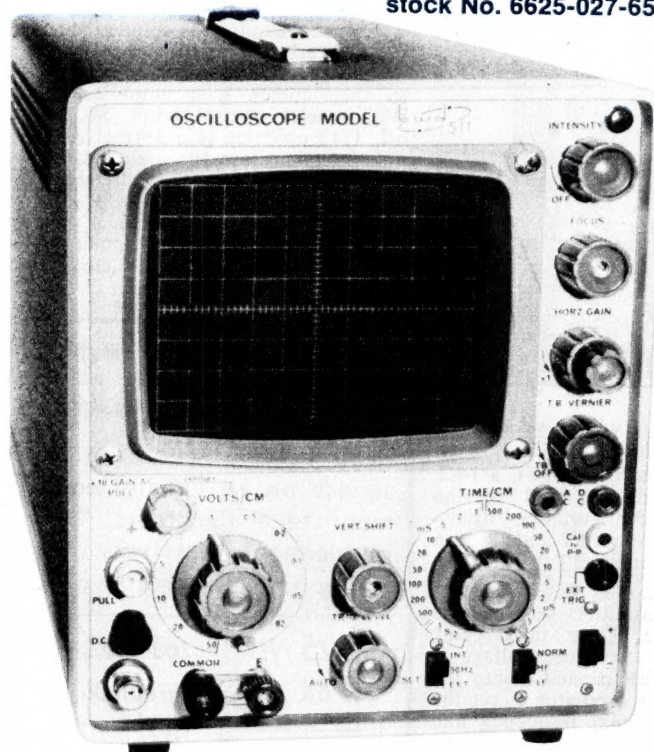
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Tr13. The squelch pot is normally adjusted so that the emitter/base voltage is just bucked sufficiently to cut off amplification.

Transistors Tr14 and Tr15, connected as a Darlington amplifier, are shunted across the lower end of the squelch control and ground. The input to the Darlington pair is connected to the AGC voltage point on LM372. As soon as a signal is received and an AGC voltage developed, Tr14 and 15 conduct and cause the bucking voltage on the emitter of Tr13 to fall, permitting this stage to amplify normally. Diode D2 is included so that the normal emitter voltage of Tr13 does not appear at the collector of Tr14 and 15.

The emitter of Tr13 is by-passed to ground through a 20 μ F capacitor and call switch, S2. When S2 is placed in the "Call" position, the emitter by-pass capacitor is removed from its ground connection and fed to an RC feedback network connected to the output of the main amplifier. The resulting positive feedback loop causes the whole audio stage to oscillate at a frequency determined by the RC network, in this case, about 1KHz.

If the squelch is turned on and the control advanced to the point where Tr13 is cut off, oscillation will cease. As soon as a carrier is received, however, the removal of squelch bias will permit oscillation to commence and the resultant loud "beep" in the earpiece can be heard for some distance, indicating a call being received. The call switch is then turned off and communication established in the normal manner.

All switching functions from "receive" to "transmit" are taken care of by a single 4-pole, double-throw relay, operated by the handset push-to-talk button.

Relay contacts A/1 change over the aerial connection while the 12-volt supply line is switched by contacts A/2. The input to the audio amplifier is switched from the receiver section to the microphone input by contacts A/3, leaving the remaining contacts, A/4, to disconnect the output of the audio amplifier from the earpiece and feed it into the low impedance primary of the modulation transformer, T1.

The 100-ohm resistor connected across contacts A/4 provides a suitable level of side-tone in the earpiece during "transmit" and may be varied in value as desired.

Before considering construction details, the following general thoughts on component types, ratings and so on may be expressed to advantage.

The BF115 transistor chosen for the low level stages in the transmitter, while only one of a number of types that could be used, has the advantage of availability, low cost and internal shielding. The shielding while not appearing to be essential in this case, could be an advantage in avoiding undesirable coupling effects sometimes experienced in compact equipment of this type.

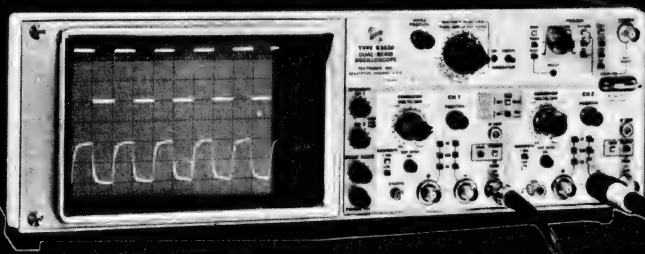
Several transistor types were tried in the PA stage. We found little difference between them, most of the factors involved, cost, availability, power gain etc. being very much the same. While we settled finally on the BLY33, this was a fairly arbitrary choice of the types tried and they could be substituted without any modification to the circuit. It must be understood, how-



NEW ADDITIONS

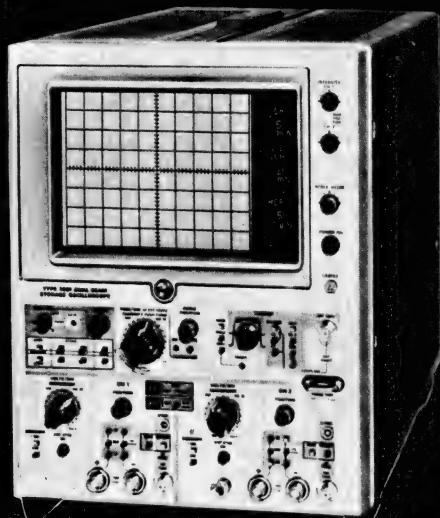
Tektronix continues to expand the 7000 Series Oscilloscope System as evidenced by the introduction of the NEW Type 7503 Oscilloscopes and NEW Type 7B52 Time Base. The 7000 Series is a full measurement system which now consists of three mainframes and fourteen plug-in units, including six amplifiers, five time-base units, a pair of sampling units, and a dual delay line plug-in unit. Three

new trace-recording cameras, six voltage and current probes, and a new Scope-mobile® are also available as accessories. Complementary to the 7000 Series, the 5000 Series of low frequency oscilloscopes is now expanded by the addition of the Type 5031 Storage Oscilloscope. Types 5030 and 5031 are both available in rackmounting and vertical or horizontal cabinet configurations.



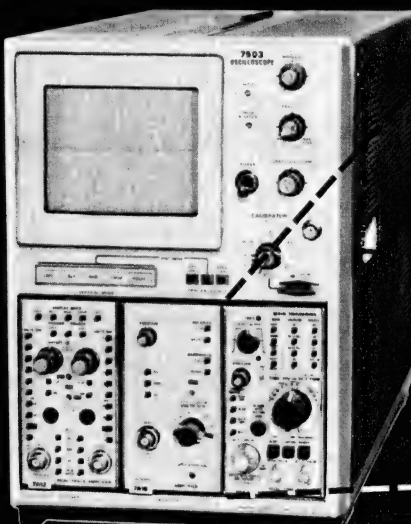
TYPE 5030 DUAL-BEAM OSCILLOSCOPE

The Type 5030 is the first dual-beam oscilloscope to offer current inputs, high gain differential inputs, auto scale-factor readout, and 1 MHz bandwidth. **Bandwidth**—Selectable: DC to 1 MHz or DC to 5 kHz. **Deflection Factor**—10V/div to 10 V/div or 1 mA/div to 200 mA/div. **Common-Mode-Rejection Ratio**—at least 100,000:1-100dB (DC to 100 kHz). **Time Base**—1 us/div to 5 s/div and up to X50 magnification. **Display Area**—each beam 8x10/div (1.27 cm/div). **Accelerating Voltage**—4kV. **Amplitude Calibrator**—0.5 V and 5 mA, 1 kHz square-wave. **Power Requirements**—90 to 140 V or 180 to 280 V, 48 to 440 Hz; 100 watts.



TYPE 5031 NEW DUAL-BEAM STORAGE OSCILLOSCOPE

The 5031 is the first commercially available, dual-beam, split-screen bistable storage oscilloscope. In addition to the characteristics of the Type 5030 instrument, the Type 5031 provides increased measurement capability and convenience through a variable viewing time storage system, which can be directed to automatically erase either, or both halves of the display area, after a predetermined time. Erase time is only 2 ms, and all display functions are remotely controllable.



TYPE 7503 OSCILLOSCOPE

The 7503 is a 90 MHz, three plug-in oscilloscope. **VERTICAL MODE SWITCHING** in the mainframe enables the user to simultaneously measure waveforms with widely different characteristics by electronically switching between two vertical plug-ins. The vertical mode **CHOPPED** and **ALTERNATE** operation, and the modular approach to plug-in selection, provides for a better match between instrument and application. This flexibility allows an unusual range and combination of multi-trace, differential, high-gain, current, and sampling input configurations.



TYPE 7B52 TIME BASE

The 7B52 Time Base is designed primarily for the 7503 which has a single horizontal compartment. But, the 7B52 is compatible with any 7000 Series mainframe as are all 7-Series plug-ins. The 7B52 features **NORMAL**, **INTENSIFIED**, **DELAYED** and **MIXED SWEEPS**.

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S3077R

QUEEN ELIZABETH 2's

The new Cunard liner "Queen Elizabeth 2" has been described as "the most carefully planned ship ever built." Evidence of this careful planning can be discerned in the large array of electronic equipment the vessel carries. This article is concerned with the portion of this equipment supplied by the ITT group of companies.

Designed from the word go to act in a dual role—carrying passengers on the North Atlantic run from Britain to America and back during the summer season, doubling as a luxury cruise liner during the winter season—the Queen Elizabeth 2 is equipped with

every modern convenience. Passenger comfort and convenience has been a major consideration all through the design stages: the ship has 13 decks and more open deck space than any other passenger liner; and more than 1,500 of the 2,000-odd passengers will have outside cabins.

The Queen Elizabeth 2 is the first passenger vessel in the world to be able to navigate by space satellite. Making use of transmissions from polar orbiting satellites of the U.S. Navy, equipment developed by ITT Aerospace of San Fernando, California, and installed in conjunction with International Marine Radio Company of Croydon, will determine the ship's position with extreme accuracy in all weathers anywhere on the high seas.

The ship-borne equipment consists of a 5ft high conical-shaped aerial, a navigation receiver, a small data processor, a teleprinter and paper tape punch. It is essentially automatic and does not require skilled or highly trained operators.

Orbiting at an altitude of about 600 miles, each satellite transmits at two-minute intervals data indicating its exact position, this information having been previously fed into its memory store by special ground "injector" stations. The precise orbit for each

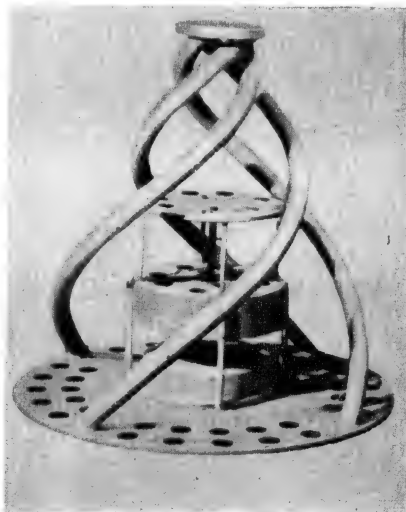
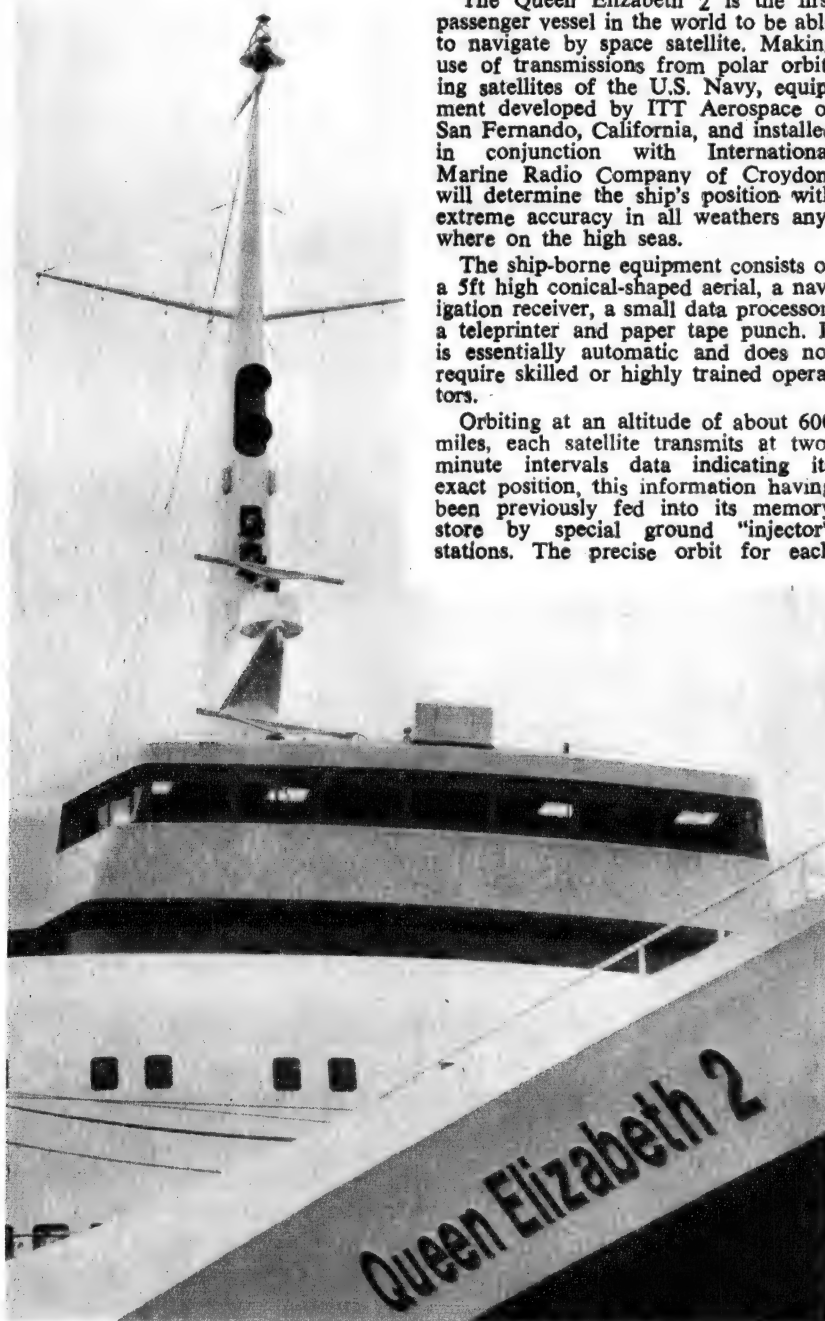
satellite having been predicted by computer from ground radar tracking measurements, information on its exact whereabouts for the ensuing 12-16 hours can be fed back into each satellite and used in its position broadcasts.

On board ship a small programmed data processor (Digital Equipment Company Limited, model PDP8/1) determines the ship's position from the received orbital data and from Doppler shift data provided by receiving equipment. The position can, in fact, be determined with extreme accuracy. When used as a completely self-contained receiving system, isolated from all sources of information except the satellite, position fix accuracies of the order of one-tenth of a mile can reasonably be expected. However, when used in conjunction with a second unit (on land), which is in simultaneous view of a satellite "pass," the relative position of one set with respect to the other can be determined to within 10 to 50ft.

The radio communications system is designed for extreme flexibility in use, and in this respect the Queen Elizabeth 2 is in advance of any other vessel in the world.

For nearly 40 years the International Marine Radio Company has been providing radio communication and navigation aids equipment on Cunard's passenger liners, including the two previous Queens, the Queen Mary and the Queen Elizabeth. Now the major part of the comprehensive radio system on the Queen Elizabeth 2 also has been installed by IMRC, the radio room being fitted out almost entirely with IMRC/STC/ITT equipment.

The heart of the radio communications complex is the receiving/operating room, situated aft of the bridge.



UNIQUE ELECTRONICS

Simultaneous independent working of four radio-telephony or radio-telegraphy channels is possible, there being four separate operating positions, each with its own aerial pre-selector unit (providing a selection of six aeriels), a high-grade communications receiver (supplied by GEC), a transmitter exciter unit and remote-control unit, and an operator's control unit. Two of these operating positions have been built into pedestal-mounted console units, capable of being rotated through 90 degrees. This enables the radio officer at one of the fixed positions to take over and control a second operational position during periods when traffic is not so heavy.

"Split" headphones, having separate inputs to each earpiece, facilitate the simultaneous monitoring of two receivers. A main 500KHz distress frequency watchkeeping channel is provided in each headset selector unit, with automatic switching to a loud-speaker should all operators be occupied.

The control and switching panel at each operating position permits the radio officer to converse with the ship's telephone exchange operator to discuss details of outgoing and incoming radio-telephone calls, advance booking of calls, etc. Through this control panel, special circuits provide for direct communication with the bridge, the public address studio and similar places, and radio circuits can be made available to these points. In addition, it is possible to select here the use of teleprinters, to effect radio-photo reproduction, to switch either VOGAD (Voice Operated Gain Adjusting Device) or Lincompex (Linked Compressor and Expander) equipment in or out of circuit to improve speech quality, and to insert speech scrambling equipment to preserve privacy of conversations.

Because of the multiplicity of aeriels used in the complex transmitting and receiving system—notch aeriels, whip, dipoles and long wire—the aerial to be used is selected at each control position. A specially designed electronic display panel enables each operator to check the availability of all the ship's

aeriels, to see which are in use, and to which transmitters or receivers they are connected. Also displayed is the frequency band and channel that each of the transmitters is operating on. A receiver aerial patching panel facilitates the cross-patching of aerial feeds from remote receiving aeriels to all receivers, including those located on the bridge, and a special feed to the sound reproducing equipment room. A supervisor's patch panel facilitates the monitoring and cross-patching of audio outputs from all receivers, the telephone exchange audio cables and lines to the bridge, the sound reproducing room and the public address studio.

It is also possible to communicate by teleprinter from the Queen Elizabeth 2 directly into the land telex networks. Accurate messages are ensured by the use of UNITEC error correction equipment supplied by STC. This detects errors caused by fading, noise or interference and applies a correction to those characters received with only a single element error. On those infrequent occasions, when more than one element error occurs in any character, a symbol is printed showing an error has occurred. During the Queen Elizabeth 2 acceptance trials as many as 20,000 words of Press material a day was handled.

Three of the latest type of teleprinter manufactured by ITC Creed are employed on the Queen Elizabeth 2. Two of these are used for these ship-to-shore communications. The third is used to print out information from the liner's computer.

The radio transmitting room, sited just forward of the funnel, is normally

unmanned. It houses the remotely controlled power amplifiers of the four main transmitters, the exciter units and remote tuning controls for these being situated in the radio receiving room. One transmitter, type ST 1400, operates on both the medium-frequency and high-frequency bands (405-525KHz and 1.6-25MHz) and has an output of 1.5KW p.e.p. This was developed by STC's Swedish associate company, Standard Radio & Telefon, and was specially modified at IMRC's Croydon works for installation on the Queen Elizabeth 2. Three other transmitters, type ST 1430A, operate at HF only (1.5-25MHz) and have outputs of 1KW p.e.p. These, too, were developed by SRT and supplied and installed by IMRC.

All four of the main transmitters have full double-sideband and single sideband capability for radio-telephony and equivalent facilities for radio-telegraphy. They operate into a variety of aerial systems, including notch aeriels, the tuning of which is effected by remote control from the radio receiving room, as previously explained.

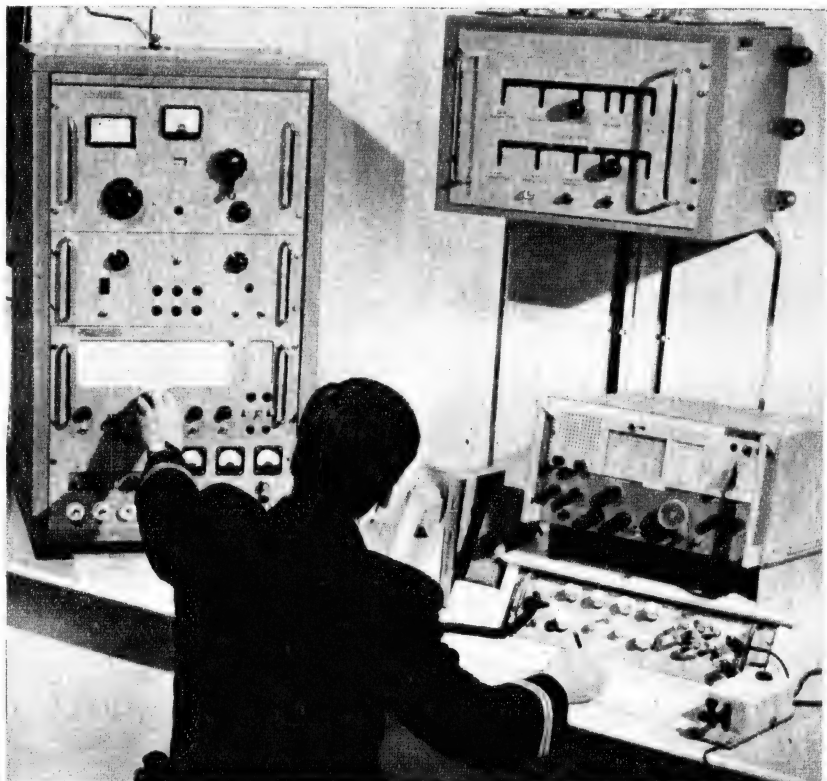
Also situated in the radio transmitting room is a transmitter, type IMRT-113, for reserve/emergency operation in the medium-frequency band, complete in a single-rack with a reserve/emergency receiver type SR.401, an automatic keying unit and facilities for switching to battery operation. On/off switching, keying, and aerial selection for this unit, can also be undertaken from the receiving room.

As well as the outstanding facilities provided for long-distance com-

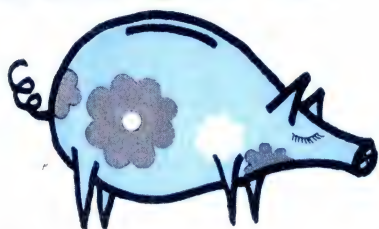
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LEFT: The helix shaped structure sited atop of the mast is the aerial for the satellite navigation system. A close-up is in the smaller picture.

RIGHT: Equipment for the Queen Elizabeth 2 under test at Croydon works of the International Marine Radio Company. On left is a standby receiver, and right is a high-stability main receiver.



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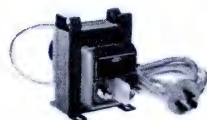
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LAUN. TAS.	22.844
PERTH. W.A.	23.1971
ADEL. S.A.	8.2271
BRIS. QLD.	211933



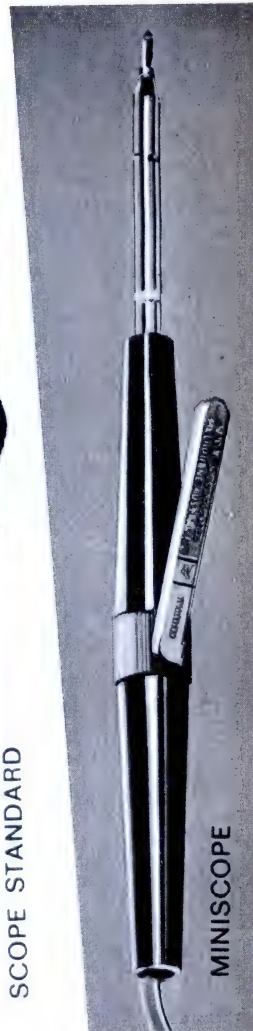
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Consumes current only whilst in use. Scope De Luxe performs all the functions of other irons from 40 to 150 WATTS.

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Temperature control at your finger tips. Heat only when, where and as much as needed.

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Ideal for those almost inaccessible spots. No burning of adjacent insulation.

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ONLY 5 to 6 seconds' initial heating up time from cold, then practically instantaneous.

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Scope De Luxe weighs only 3½ ozs. complete. Miniscope 1½

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Fully guaranteed with time tested dependability.

SAFETY

Low voltage operation. Heat sensitive components protected.

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Longer tip life. NO expensive heating elements to replace. Maintenance without special tools. Spare tips and elements readily available from your Scope Distributor.

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munications, the Queen Elizabeth 2 carries VHF radio-telephone equipments for ship-to-shore communications, both for use by ship's officers and for public correspondence with coastal stations within range.

Of the four VHF transmitter/receivers installed on the bridge of the Queen Elizabeth 2, two are remotely operated from the radio receiving room.

One of those on the bridge, type STR 20 (10W, 16 channels), is used for communication with the ship's launches. The other, type STR 60 (20W, 41 channels), provides communication with tugs, harbour master's office, radar stations, etc., when entering or leaving port.

The two VHF transceivers remotely controlled from the radio receiving room, both STR 60, are primarily used for passenger or crew public correspondence services. If necessary, however, they can be used for ship-to-ship calls, port operations or distress services, thus supplementing the equipment normally operated from the bridge. These VHF equipments were manufactured by Standard Electric A/S of Copenhagen and installed by IMRC.

Almost every means of local and long-distance communication that would normally be available to them ashore is available to the 2,000 or more passengers who can be accommodated on the Queen Elizabeth 2.

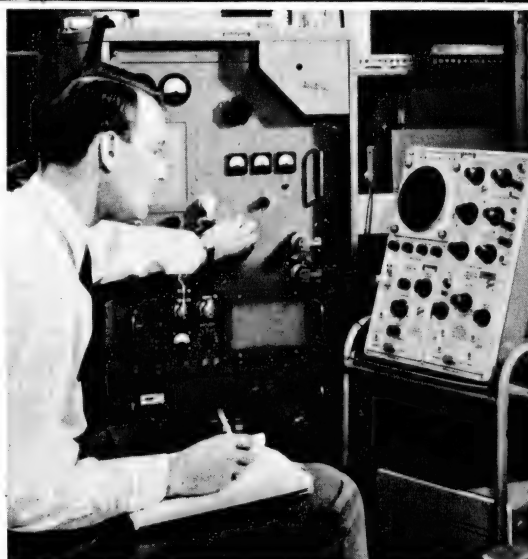
The type of telephone exchange considered suitable for the high-grade personal service called for was a hotel-type PABX (Private Automatic Branch Exchange) having a manual switchboard. A specially designed 1,360-line exchange based on the G.P.O.'s type 3 PABX, and having a three-position cord-type manual switchboard, was supplied and installed by S.T.C.'s Private Communications Division at Footscray, Sidcup, Kent. This exchange provides 1,000 telephone extensions to passenger cabins, plus a further 360 extensions for ship's officers and crew and to working areas.

Timing and monitoring devices are included on the manual switchboard positions.

Telephone operators, located on No. 2 deck, provide a personal service for calls between passengers and between passengers and the crew, as well as for passengers' calls from ship to shore when the ship is docked. They are

ABOVE: A section of the radio receiving-operating room. The officer at centre rear is operating the remote controls of one of the long-distance transmitters. At left are the remote controls of another long-distance transmitter.

RIGHT: A type ST 1430A transmitter under test. These are remotely controlled and automatically tuned.



able also to arrange connection of radio-telephone calls while at sea. Really high-quality radio circuits are available for this latter purpose. Two high-frequency channels of the ship's radio telephony equipment are fitted with Lincompex terminals. Lincompex largely eliminates those variations in speech volume caused by fading, and reduces radio noise to a minimum, effectively suppressing noise between syllables of speech, thus making for easier conversations between callers.

For the businessman requiring speedy two-way communication with a written record, there is access from the ship into the U.K. telex service through the ship-to-shore radio teleprinter service.

Passenger telephones in the cabins of the Queen Elizabeth 2 provide automatic direct access to 30 of the ship's services, such as shops, hairdresser, and laundry. Calls to other passengers and ship's officers are made via the manual switchboard. Passengers can also learn the exact time, recorded in four languages, on a "speaking clock." The separate network of 360 extensions for the use of the ship's officers and crew only is fully automatic.

A separate telephone network is available for damage control emergency use. Provision is made beneath each break-glass fire alarm unit for a telephone handset to be jacked in, so providing direct connection between

the control room and the locality in which trouble has occurred.

There are in addition 46 shore lines: provision is made at both Southampton and New York for direct telephone connection to be established directly the Queen Elizabeth 2 docks from the ship's exchange into the national telephone networks. By this means 30 lines are made available to passengers still aboard to telephone directly from the ship while it is in port, instead of having to disembark and use quayside telephone facilities. Another 16 lines are exclusive to the ship's business, including direct lines to the Cunard office.

The cabling requirements for the 1,360-line telephone exchange on the Queen Elizabeth 2 were in some respects similar to the requirements of an exchange serving a small suburban area, but the installation problems were far more acute. Hitherto the normal method of installation has involved pulling separate cables through the distribution network from the telephone exchange to the various outlets. For the Queen Elizabeth 2 both time and cost were at a premium, so it was decided to resort to a technique that had never previously been adopted by the ship-building industry, although frequently employed in other applications, the technique of prefabricating the complete cable installation in harness form.

It was found that conventional multi-

(Continued on page 189)

MOBILE VIDEO RECORDING

The A.B.C. has introduced a new concept into local television broadcasting in Australia, by bringing into service a small mobile recording unit equipped with video tape facilities.

The A.B.C.'s regional television stations provide news coverage and other programs of local interest, to supplement the main program material relayed from the studios in the capital cities over microwave links. Capital city stations use comprehensively equipped outside broadcast vehicles for on-the-spot live broadcasting and video recording. These units are virtually fully equipped studios on wheels, provided with several broadcast quality cameras, full monitoring and control facilities, and high quality microwave links. (Wide use is also made of filmed material for local news coverage.)

Since units of this complexity could not be justified for regional stations, local reporting has had to depend on filmed material alone. The limitations of film, and the delays occurred in processing have severely restricted the local cover of the regional stations. To provide fully effective local cover, mobile video tape recording facilities are essential.

Recently the A.B.C. decided to provide small vans to meet these requirements for the Rockhampton and Townsville regional stations. The basic requirements for these vans was a single camera video tape recording unit to provide adequate cover of sporting events, news magazine interviews, and other items of local interest for documentary type programs.

After a study of the problems involved, including the economic ones, the following specification was adopted for the vans:

The complete equipment should be carried in a station wagon vehicle

which should also serve as the production centre for the recording and assembly of programs. The vehicles should be air-conditioned.

The van should be simple to set up on location, and should be capable of being operated by two technical staff, together with production staff as required, i.e. producer, commentators, interviewers, etc.

The van should be capable of being operated from single phase 240V, 50Hz mains supply, or locally generated 240V, 50Hz supply.

The recorder should be a professional unit, capable of recording video and audio, and having comprehensive insert and assembly facilities. It should be capable of recording for at least one hour continuously on a single tape. The unit must be sufficiently stable to permit direct replay to air or transcription to an Ampex VR1000C recorder.

The camera should be a lightweight broadcast quality vidicon or Plumbicon camera having a low power consumption and no separate camera control unit. It should be fitted with a zoom lens.

Audio mixing facilities for at least four separate microphone channels are necessary.

Full intercommunication and talkback facilities are required.

The equipment should be designed for monochrome only, and no luminaires or lighting control equipment need be provided.

The vehicle selected was a Ford Fairmont station wagon which was

fitted with a V8 engine, disc brakes, modified engine cooling system, heavy duty tyres, heavier suspension and a number of other facilities.

The operating position has been chosen such that one operator within the van is seated in the driving position whilst the second operator sits in a separate seat directly behind the driver. All operational equipment is located in a specially designed frame situated on the left hand side of the vehicle. The operating position is designed so that the operator in the front seat controls the video recorder and audio facilities, whilst the operator in the rear seat controls the intercom and talkback system together with a number of secondary controls. The layout has been arranged so that one operator seated in the forward seat can adequately operate all the equipment, if necessary.

The camera selected was an Ampex BC300. This is a Plumbicon camera of broadcast quality and includes an electronic viewfinder, an integral synchronising pulse generator and a zoom lens. The camera can be operated from a battery pack or from 240V mains, and does not require a separate camera control unit. One big advantage of this camera is that it may be hand-held or tripod mounted, and it requires only a single video cable feed to the van. A cable compensator has been provided to enable up to 200ft of camera cable to be correctly equalised.

The video recorder is an Ampex VR7800-03 which is a single head, 1in helical scan machine. The recorder has comprehensive insert and assembly facilities for both video and audio, and it includes an output processor which ensures continuity of synchronising pulses in the video output waveform. The recorder has been wired so that it is normally locked to the camera signal. However, it can be locked to station sync. for replay at the studios.

The vision equipment includes a synchronising pulse generator which is gen-locked to the camera, and a ten step grey scale generator which is used for alignment and test purposes. A high quality 8in picture monitor and a professional waveform monitor are also included, and these may be switched to monitor various video signals. Program vision is available at all times for use external to the van for commentator's picture monitors, etc.

Audio facilities are provided by a four channel mixer, together with a compression/limiter amplifier. The program sound is fed through an amplifier within the recorder to a small loudspeaker located within the van. Program sound is also available at all times for use external to the van.

The intercom and talkback system comprises a base unit installed in the van, together with separate remote units for the cameraman and the commentator.

The cameraman is fed with program sound and production talkback, and the commentators receive production talkback and intercom. In each case the



Interior view of the prototype mobile video recording van.

UNITS

intercom and talkback is carried on a single run of microphone type cable.

All connections external to the van are made through a single connector panel which is situated in the centre of the rear bumper bar of the van. Additional facilities include a tripod with pan and tilt head, a roof platform with tripod clamps, an automotive type air-conditioning unit of about 20,000 B.T.U. capacity, microphones, stands, 9in house-quality picture monitors, and headsets.

All cables are wound on aluminium cable drums carried in the rear of the van. The drums accommodate the following lengths of cables: 700ft power cable, 1,000ft video cable and 1,200ft of audio/talkback cable. A cable winder is also supplied.

Extensive investigation was undertaken to determine the most suitable means of providing the internal 240V, 50Hz power source for this van, and it was eventually decided that generation of 24V DC from the vehicle engine, together with an inverter, would provide the most flexible and reliable system. This had the added advantage that operation of the equipment would then be possible while the van was being driven.

The internal power source comprises two alternators driven from the vehicle's engine, with rectifiers providing two supplies of 55 amps DC, one being at +12 volts and the other at -12volts. This output is used to continually charge two 12V lead acid batteries located in a ventilated battery box in the rear of the vehicle. These two batteries are connected in series to supply 24V DC to a 1KVA solid state inverter whose output is then available to feed the equipment. Control of the internal power is by means of a magnetic clutch mounted on the fan pulley of the vehicle and a hand throttle. The two batteries are normally charged continuously by the alternators; however, should a fault condition arise, the equipment can operate for about 1 hour from fully charged batteries.

Core balanced circuit breakers are fitted to both the internal and the external power supplies to provide personnel and equipment protection in case of a mains fault situation arising.

The van has now been in service for several months and has proved to be quite successful within the limitations of a single camera. Perhaps its greatest advantages are that it may be driven to any location in the same way as a normal motor vehicle would be driven, and that it can be set up by two people in less than one hour, even for a relatively complex program. This enables the van to be used both for normal coverage of lengthy outdoor functions, such as sporting events, and for local news reporting. It has been found that material may be recorded on location, then replayed to air approximately one hour after completion of recording. ■

ACCOUNTS QUERIES ANSWERED IN SECONDS

An IBM computer system installed by Melbourne's Gas and Fuel Corporation provides information against customers' accounts queries in seconds.

The computerised inquiry centre, the first of its kind in Australia, was officially switched on recently by Mr Neil Smith, chairman and general manager of the utility. More than 20 terminals are installed in the centre to handle both over-the-counter and telephone inquiries. Operators merely key-in the customer's address or account number to retrieve a display of account information on the screen of an IBM 2260 Visual Display Terminal.

The terminals are connected to an IBM System/360 Model 40 at the Gas and Fuel data processing centre. Details of meter readings and customer accounts are kept on magnetic discs in two IBM 2314 direct access storage facilities. Each can store some 400-

the time to answer inquiries. An even more exciting application of the computer, one which will improve customer service still further, is currently being examined. Under the extended system a customer calling for service will be given a definite appointment immediately, the computer allocating the work to an individual fitter and issuing the necessary job tickets and other documents automatically. Unfortunately the complete system will not be available to help us over the winter months ahead, but, in the meantime, customers will note a much more rapid response to inquiries relating to the financial side of the account."

Internally, Gas and Fuel Corporation credit officers use the terminals for



One of the IBM 2260 Visual Display Terminals used in the system.

million digits of data and the computer can retrieve a customer's record in 75 milliseconds.

The system has reduced the time required for answering accounts queries from an average of four minutes to 30 seconds. Queries include problems with accounts, or requests for final bills from people moving premises.

As the customer explains the problem or makes his request, the operator sees details of the account displayed on the screen. For instance, a report of a sudden rise in gas consumption can be checked immediately against past history, and, possibly, traced to new appliances, while the customer is on the phone. If no satisfactory explanation is found on the basis of available data, Gas and Fuel engineers can be alerted immediately to trace the trouble.

Describing plans for extension to the customer inquiry system, Mr Smith explained, "This initial application is only the first part of a fairly long term project to enhance our service to the gas consuming public. Our aim is to reduce costs and at the same time reduce

quick checks on delinquent accounts. A decided advantage of the new system over the conventional procedures is the ability it gives the officers to immediately alert the computer, via one of the terminals, on payment of arrears as agreed by a customer.

At the inauguration of the new system, Mr Smith said: "With the aid of the terminals we have reduced the average time for answering a telephone inquiry from approximately four minutes to 30 seconds, that is, a factor of eight. The inquiry centre handles up to 2,500 account inquiries per day. Time savings are therefore most significant in gaining customer goodwill and in promoting service efficiency."

"We are particularly impressed," Mr Smith added, "with the speed and ease of implementing the system and of training our inquiry staff."

Mr J. P. Watson, manager of systems and data processing at Gas and Fuel Corporation, pointed out that operators required only a few hours of familiarisation in the handling of inquiries with the aid of the terminals.

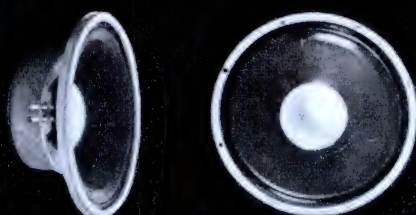
JBL

Musical Instrument Loudspeakers



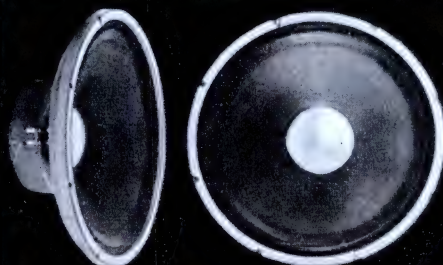
D110F SPECIFICATIONS

Nominal Diameter	10 inches
Magnetic structure	6 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	3 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	10,200 Gauss
Total Flux	170,000 Maxwells



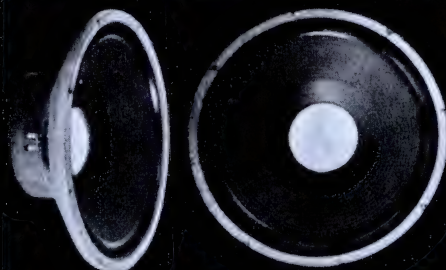
D120F SPECIFICATIONS

Nominal Diameter	12 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D130F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D140F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	150 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Copper Ribbon
Flux Density	11,500 Gauss
Total Flux	260,000 Maxwells

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MOVING MAP AIR NAVIGATION SYSTEM ON TOUR

A new Marconi airborne navigation system with an advanced pictorial display is currently being demonstrated under operational conditions in the company's Piaggio aircraft to representatives of major airlines from the United States, Europe and the U.K.

The Marconi Type AD670 fully automatic area navigation display can cover an entire airline route structure. The current tour provides the first opportunity that the majority of aircraft operators have had to evaluate the advantages of this type of automatic area navigation presentation in airborne operation.

The system is based on a 6-inch diameter moving map display, using back-projection film techniques to present a detailed map of the area in which an aircraft is flying. The map moves under the control of a navigation computer, to show the "present position" of the aircraft at the centre point of the display. The pilot can see at a glance his position in relation to any required track, waypoint or destination, and can identify navigational aids or topographical features with reference to this position.

This system is completely automatic, and can operate from any of the normal "en-route" navigational aids including doppler and inertial systems, VOR/DME, and all types of hyperbolic navigation aids.

A major advantage of the Marconi moving map display is the very large film capacity — more than four times that of other types of moving map display, and sufficient to accommodate on one film a series of at least 1024 overlapping maps covering the entire route structure of any airline in the world, with additional space for procedural check lists and lists of radio facilities. A choice of up to four map scales can also be provided on the same film strip. A military operator could cover his entire area of operations on a single film. It would even be possible to accommodate the vast majority of all the international routes of all airlines in the world.

This very large storage capacity, capable of holding at least 130ft (39 metres) of film in a single loading, will largely eliminate the need to change the film in normal operations, and this in turn will greatly increase the reliability and operational effectiveness of the system as a whole.

Separate frames on the film provide four different map scales on the same film strip. This provides greater detail of ground aids, airways or topographical details. These four different scales can be provided to suit any particular operational requirement, and are selected by means of a switch on the display unit.

The system can be switched to give either a track-up or a North-up orientation of the display. In the track-up

mode, the pilot can also switch to a "Look ahead" presentation, in which the "presentation position" point is moved from the centre to a point near the bottom of the display, in order that the maximum portion of the map display is used to show the area ahead of the aircraft.

All of the map frames overlap with adjacent sections of the map, to avoid any discontinuity of display as the aircraft approaches the edge of the map frame. Well before this edge is reached, the computer moves the film automatically to the next appropriate section of the map, which also has an overlapping area. At the same time, the computer ensures that a map frame of

demonstrations, the Marconi team have been able to show that the map can still be clearly seen with sunlight falling directly on the face of the display. Four independent lamp units are housed in the display, to provide immediate replacement in the event of a lamp failure.

The equipment can also provide a vertical navigation display, to enable a pilot to follow a let-down path accurately at any given angle. The display will present height plotted against a horizontal scale of "distance to waypoint," with lines running across the display to correspond to a range of let-down angles. Data from the air data computer system provides an altitude



The moving map display in the cockpit of the Marconi Company's Piaggio demonstration aircraft.

the correct scale is selected, and that the position and orientation of this map are correctly displayed. Any type of map projection, or a combination of different projections, can be used with the display system, and the appropriate co-ordinate conversion functions provided in the computer. In civil use, the display will normally use airways and en-route type navigation charts, at a scale appropriate to the information required.

High visibility over a wide viewing angle is another important feature. Several levels of projector illumination can be provided, and selected by a switch, to suit extreme variations in light level on the flight deck. During the current

input while distance to go to the waypoint is provided by the navigation computer.

The complete system has been designed to take maximum advantage of the latest integrated circuit techniques to provide very high reliability and small size and weight. A wired-in program provides all the facilities necessary for any specified set of customer requirements, but results in a much simpler computer system than would be needed if facilities were to be provided to change the program.

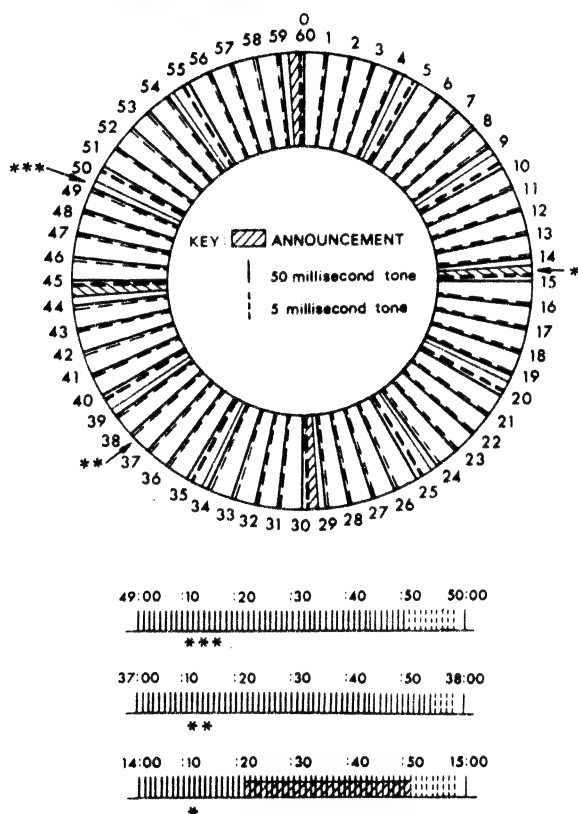
The computer can be used to drive digital displays of range and bearing, or of Northings and Eastings if required. ■

IMPROVED TIME SIGNAL SERVICE

Following the installation of new equipment at the P.M.G.'s Time Signal Service Station at Lyndhurst, Victoria, the carrier frequency is now stabilised to a high degree of accuracy.

The time signal service from VNG Lyndhurst provides precise time signals for the use of scientists and other interested parties. Typical of those who make use of the service are astronomers, seismic and geophysical exploration teams, observatories, academic groups, industrial organisations and Government departments.

VNG TIME CODE



This diagram represents transmissions from VNG over a one-hour period. Signals are coded to indicate each second, each minute, each fifth minute, each quarter-hour and each hour.

The first four minutes of each five-minute period have identical coding: a 50-millisecond tone is transmitted to mark each second from the first second of the minute to the 54th second; the 55th second to the 58th second are marked by a 5-millisecond tone, the 59th second is silent, and the minute is marked by a 50-millisecond tone. The pattern is then repeated for the next three minutes. (This pattern is marked by two stars in the diagram.)

At every fifth minute, 50-millisecond tones are transmitted each second from the first to the 49th second, followed by 5-millisecond tones from the 50th to the 58th second, the 59th second is silent, then the minute is marked by a 50-millisecond tone. (Pattern marked by three stars.)

The code for the minute preceding the 15th, 30th, 45th and 60th minute is identical with the fifth-minute code, except that there is a 30-second announcement identifying the station from the 20th to the 49th second. The 50th to the 58th second are marked by the 5-millisecond tone, the 59th second is silent, then the hour is indicated by a 50-millisecond tone. (Pattern identified by one star.)

Similar services are operated by overseas organisations on carrier frequencies set aside for the purpose by international agreement. While such transmissions from overseas are valuable, they cannot always be received and used in Australia because of the lengths of the transmission paths involved. Apart from fading, other factors which have to be considered are confusion arising from reception of more than one service on the same carrier frequency, and propagation delays.

The transmissions from VNG are at present classed as experimental, and as such they do not take place on carrier frequencies reserved for time signal transmission. The present schedule of VNG transmissions is as follows:

TIMES OF EMISSION		FREQUENCY
UT	AEST	KHz
0945-2130	7.45 p.m. — 7.30 a.m.	4,500
2245-2230	8.45 a.m. — 8.30 a.m.	7,500
2145-0930	7.45 a.m. — 7.30 p.m.	12,000

The time signals transmitted from VNG have been controlled by a caesium beam standard from the inception of the service in 1964. Now the carrier frequencies are also accurately stabilised from the same source. In addition, the power of the transmissions has been raised from 1KW to 10KW.

The accuracies and stabilities of the service are now as follows;

CARRIER FREQUENCIES. Stability will be maintained such that average daily fractional frequency deviations from the nominal value do not exceed plus or minus one part in 10^{10} . Nominal in this case refers to the value derived from the standard for measurement of the time interval UTC (APO) maintained at the Australian Post Office Research Laboratories, and which is referred to the Universal Co-ordinated Time scale as determined by the Bureau International de L'Heure (B.I.H.).

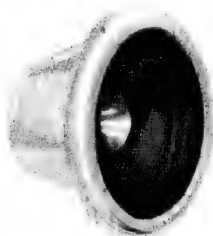
The Lyndhurst site has its own controlling and standby frequency standards which maintain the carrier frequencies and time signals to a very close tolerance. Off air measurements of the transmissions are made daily at the P.O. Research Laboratories. A VHF link from Lyndhurst to the laboratories also continually supplies frequency and time information with minimum degradation, since VHF propagation is less subject to disturbance than are HF transmissions. VHF transmissions are not usually subject to ionosphere changes, and it is ionospheric disturbances which places probably the greatest limitation on the accuracy attainable in disseminating time and frequency information by HF transmissions.

The frequency standard system at the VNG transmitters is controlled from the research laboratories by a signal sent via landline. The crystal oscillators at Lyndhurst incorporate motor driven capacitors, which are used to correct the crystal frequency as variations occur.

The frequency controller at Lyndhurst allows the frequency of the controlled oscillator to be maintained within one part in 10^{11} of the controlling standard. Information to the controller is provided by a frequency in the VLF range derived from the master oscillator at the research laboratories and sent to the Lyndhurst site via landline.

The advantages of this is that should the controlling frequency vanish for any reason, the controller will hold the controlled oscillator tuning capacitor to the last known controlled position until the reference frequency is restored. The time constant of the frequency controlled loop can be varied up to a maximum of several days to suit the conditions under which the control operation is taking place. ■

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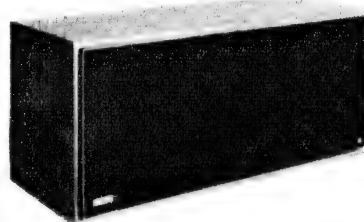
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Background Information

An understanding of this article presupposes a knowledge of the principles of operation of linear induction motors. Readers not familiar with these motors may find the following helpful.

The linear motor is similar in principle to the "squirrel cage" type of polyphase rotary induction motor. With the later type of motor, the rotor is induced to turn in its bearings by following the rotation of the magnetic field produced around it by the stator. The rotor itself is magnetised by induction from the stator windings. The advantage of this type of motor is its simplicity, since it requires no brushes or rotor windings.

Assume now that it is possible to cut through the stator assembly in one place, and lay it out flat, without interrupting electrical continuity of the windings. The magnetic field now will travel continually in one direction along the length of the stator. The "rotor" now can be a flat rod, or rail; or, as in the case of the liquid metal pump, molten metal in a tube. The rotor and stator can reverse roles, so that the windings move along a fixed rail.

The development of the linear motor could be said to have taken place in three distinct phases. Invented in 1890, the first phase occupies the period almost up to 1950, during which time a number of attempts were made to apply it commercially, most of which came to the conclusion that it was costly, inefficient and belonged only, perhaps, to a museum of scientific curiosities.

There was one notable exception during this phase which, in one sense, indicated the way in which future developments would occur. This was the liquid metal pump which involved several forms of construction, in all of which the effective airgap was much larger than that of the conventional rotary motor. Figure 1 shows a cross sectional view of a double-sided flat type. The liquid metal, a mixture of sodium and potassium, is contained in a stainless steel walled tube so that the total airgap in the magnetic circuit is several inches. (Stainless steel is virtually non-magnetic.)

The designers knew that the efficiency and power factor were bound to be low, but in this case even an efficiency of 10 per cent might be justified on the grounds that the pump had no

moving parts to wear out so that maintenance could literally be nil. This was most important when the pump was to be used to remove heat from nuclear reactors where the metal was radioactively contaminated. A tubular form of pump was also developed. Tubular motors are easy to construct because their primary winding consists only of a row of simple coils, but if there is a burn-out, it is necessary to break the pipeline in order to replace the winding, whereas the primary units of a double-sided flat machine can be removed without touching the pipe line. For this reason the flat machine was preferred.

The liquid metal pump was a clear example of an inefficient machine proving profitable in terms of overall economics. During the early part of this century efficiency was almost the only yardstick for the measure of machine quality. But there are fashions in engineering almost as there are in clothes and the most modern of such fashions often asks not so much the question, "How efficiently can it be done?" as, "Can it be done at all?" Thus one hardly asks what an instrument in an Apollo rocket costs; one only asks how reliable it is. At a less

LINEAR MOTORS— inefficient but effective

Linear motors, almost totally neglected since their invention 80 years ago until fairly recently, are now considered practical units for some specialised applications, and are already being used in atomic power plants.

by Professor E. R. Braithwaite

Dept. of Electrical Engineering, Imperial College of Science and Technology

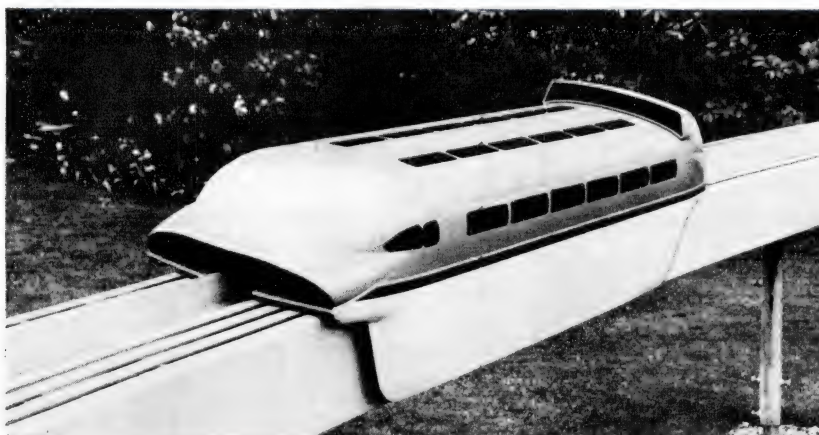
extreme level the present fashion in engineering is to examine the whole effect on the economics of a system before condemning a device as "inefficient." It is also worth noting that the very word "efficiency" has been much misused in the past by those who really meant "effectiveness," for the scientific meaning of efficiency is simply the ratio of power output to power input. One is not therefore over-concerned that the efficiency of a television set is less than 1 per cent! It is certainly a very **effective** device. Devices whose job is to produce force or pressure without movement have **zero** efficiency, but they can play most important roles in an engineering system. In modern economic assessment reliability, freedom from wear, absence of noise, absence of unwanted waste products are often given equal or greater consideration than power factor cost, efficiency and even power/weight ratio.

Phase 2 of the development of linear motors did not depend on this change of fashion, however. It would have happened anyway, for it consisted of a number of academics (including the author) becoming intrigued with the fundamental mechanism of the linear motor and pursuing academic research on the device to the point where it became clear why the early motors had had such poor performance. In certain applications the research showed that highly efficient machines might be developed. In others it showed how to make the best of what was available (a daily problem in engineering).

Phase 2 occupied the period from 1950 to about 1965. Phase 3 began when industry took on the manufacture of linear motor units for a variety of purposes and it is the main purpose of this article to deal with this aspect of the subject.

It emerged during the academic phase that the applications of linear motors might be divided into three main classes:

- (1) Machines required mainly for force production where the criteria of quality were force/weight, force/cost and force/unit of power input.



A model of a tracked air-cushion train propelled by linear motor, demonstrated in U.K. in 1966

could really only be represented by a whole "family of curve families."

Because of this, if one simply designs the biasing circuit of a transistor stage to supply the device with a fixed base current, the resulting operating point will depend very much on the gain of the particular device concerned. Only with a nominal or "bogie" device will it be near the optimum point, while with very high or very low gain devices it may be well away from this position.

Quite apart from parameter spread, there is a second major factor which complicates bipolar transistor bias design. This is that many of the key device parameters determining the operating point of a bipolar device are significantly temperature dependent.

Beta itself is temperature dependent to a moderate degree, usually tending to rise slowly with temperature. However, this is a second-order effect, and usually of far less practical significance

because with these devices I_{cbo} is typically some three orders of magnitude lower — only a few nanoamps at 25 deg.C. The relative magnitudes and temperature coefficients of I_{cbo} for silicon and germanium devices are illustrated in the diagram of figure 12.2.

It is true that the extent to which I_{cbo} does in fact supplement any external bias depends, as we have seen, upon the effective resistance connected externally between base and emitter. The lower this resistance, the greater the proportion of I_{cbo} shunted around the base-emitter junction, and the smaller the influence of I_{cbo} upon device operation. In order to reduce the effect of I_{cbo} and its temperature dependence upon device biasing, one must therefore generally arrange the bias circuit connected between base and emitter to present the lowest practical source resistance.

The base-emitter forward voltage

source resistance, and would fall to zero in the extreme case where the source resistance was increased to produce the "constant current" situation. Hence as far as bias circuit source resistance is concerned, there is a direct conflict between the requirements for reducing the effects of I_{cbo} and V_{be} .

Luckily, there are other means available for reduction of the effects of both I_{cbo} and V_{be} , so that this conflict does not lead to insoluble biasing problems. In general, practical biasing methods involve either supplementing the adjustment of the bias circuit resistance by the addition of negative feedback, or else adoption of the approach of deliberate temperature compensation, as will be shown in a moment.

In passing, it may be noted that because of the common tendency of I_{cbo} and V_{be} to cause device currents to increase with temperature, and the fact that there is a conflict between the biasing requirements for minimising the effect of these parameters, the bipolar transistor may be regarded as having an inherent tendency toward thermal instability or thermal runaway. The current tends to increase with tem-

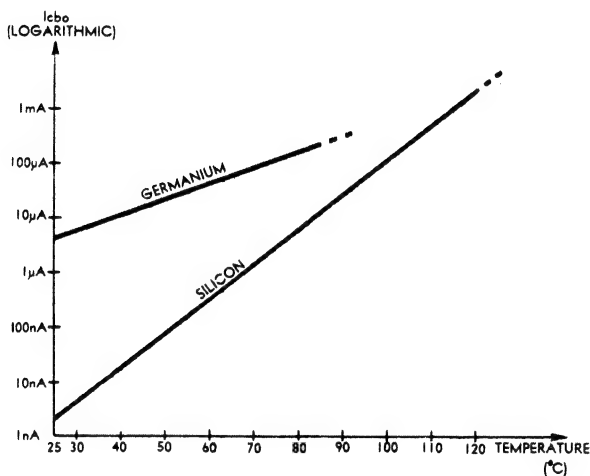


Figure 12.2

than the temperature dependence both of I_{cbo} , the reverse bias saturation and leakage current of the collector-base junction, and of V_{be} , the forward voltage drop of the base-emitter junction.

Being composed largely of minority carriers generated by the "intrinsic" mechanism, I_{cbo} tends to rise rapidly and exponentially with temperature. For germanium transistors it approximately doubles in magnitude for every 8-10 deg.C rise, while for silicon devices it approximately doubles for every 5 deg.C rise.

As we have seen in an earlier chapter, I_{cbo} tends to provide the base of the device with excess majority carriers, which in turn attract opposite polarity carriers from the emitter and so initiate device operation. In other words, I_{cbo} tends to provide an effective "internal" forward bias component, acting additionally to any bias which may be applied to the device externally.

This means that because I_{cbo} is strongly temperature dependent, there is a corresponding tendency for the effective bias on a bipolar transistor to rise with temperature, and the operating point to move accordingly. This is particularly true for germanium devices, where I_{cbo} typically has a value at 25 deg.C of a few microamps. The effect is generally somewhat less evident with silicon devices, despite the higher temperature coefficient involved,

drop V_{be} is also temperature dependent, being in this respect no different from any other forward biased P-N junction. However, in contrast with I_{cbo} , the temperature coefficient is in this case negative, corresponding to the reduction in junction barrier potential as the Fermi levels in the P-type and N-type materials approach each other with increasing "intrinsic" carrier generation. With both germanium and silicon devices V_{be} tends to decrease by approximately 2.5mV/deg.C, as shown by the typical curves of figure 12.3.

The negative temperature coefficient of V_{be} tends to produce exactly the same type of change in operating conditions as the positive temperature coefficient of I_{cbo} : a rise in base current I_b with temperature, and a corresponding change in quiescent current. And, unfortunately, the very same reduction in bias circuit source resistance which is desirable in order to reduce the effect of I_{cbo} tends to accentuate the effect to V_{be} . The lower the bias circuit source resistance, the closer the bias supply approaches the "constant voltage" situation, in which V_{be} has maximum influence on I_b .

The effect of V_{be} is actually inversely proportional to the bias circuit

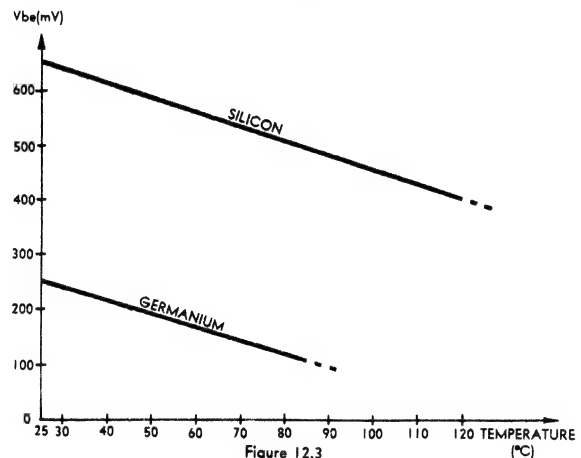


Figure 12.3

perature, and as an increase in current often tends to increase power dissipation and accordingly increase temperature, there is a definite positive feedback effect.

Unless the circuit is designed to stabilise device operation by reducing this positive feedback effect to a very low level, a bipolar transistor may either destroy itself, or at the very least cause its own operating point to slide up to the high-current "saturation" extreme of the load line.

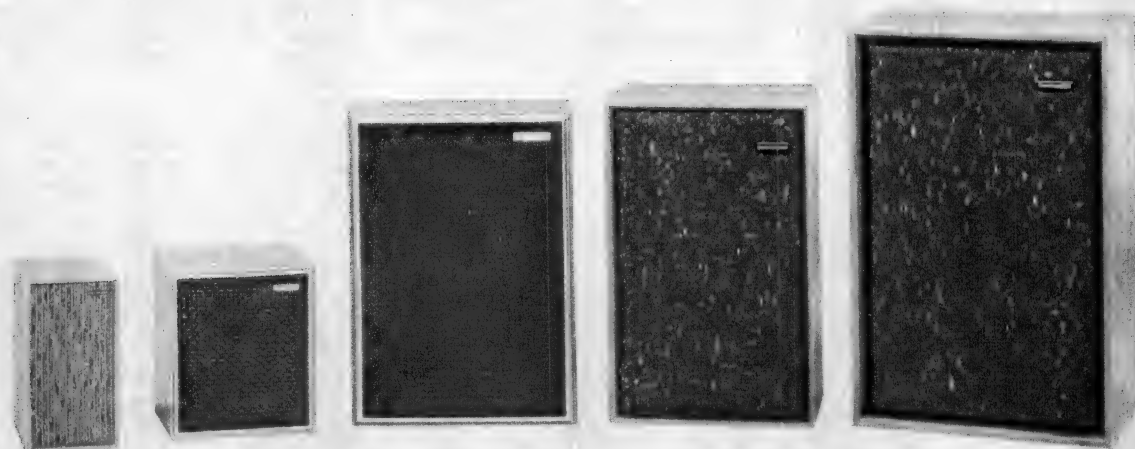
The positive feedback and tendency toward thermal instability of the bipolar transistor are in sharp contrast with the behaviour of FET devices. Not only does the actual operation of the latter devices provide an inherent negative feedback mechanism which tends to stabilise the operating point, but also the temperature coefficients of the primary device parameters are such that they tend to cause FET devices to protect themselves by moving their operating point slowly towards cut-off as the temperature rises.

Some of the more commonly used bipolar transistor biasing circuits are shown in figure 12.4. These may be used to illustrate the basic concepts introduced in the foregoing.

The simplest method of bipolar tran-

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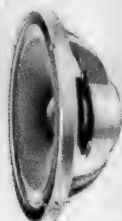
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istor biasing is known as **current biasing** or "fixed biasing," and is shown in figure 12.4(a). As may be seen, it involves a single resistor R_b which is usually connected between the base electrode and the collector supply rail. The value of R_b is arranged to produce the required base current I_b , using Ohm's law: $I_b = (V_{cc} - V_{be})/R_b$.

If the supply voltage is greater than about 6V, the effect of V_{be} in determining the bias current becomes insignificant, as V_{be} is only about 0.65V for silicon transistors and about half this value for germanium devices. This is true in most applications, so that typically I_b is effectively determined only by V_{cc} and R_b , and is independent of the device itself; hence the description "fixed biasing."

The operating point stability provided by this type of biasing circuit is rather poor. The effects of V_{be} and its negative temperature coefficient are reduced to a negligibly low level by the effectively fixed bias current I_b , to be sure, but on the other hand I_{cbo} and its positive temperature coefficient generally assume maximum significance, due to the very high resistance of the bias source. The fixed bias current also tends to make the operating point significantly dependent upon beta, both in terms of spread variation and also in terms of temperature coefficient.

It is almost impossible to obtain adequate operating point stability using current bias with germanium transistors, due to the relatively high I_{cbo} of these devices. Because of this, it is almost never used for such devices. The few exceptions are generally low power stages in very low cost equipment, intended for uncritical use within a restricted temperature range.

The very much lower I_{cbo} levels of modern silicon transistors allow current biasing to be used to a somewhat greater extent, it is true, as with these devices the effect of I_{cbo} is generally negligible at typical operating temperatures even with quite high bias circuit source resistance. However, the somewhat wide beta spread range of these devices still tends to restrict the use of current biasing to low cost applications, or to applications where either the bias resistors or the devices may be individually selected.

Some small improvement in operating point stability over that provided by current biasing may be obtained by feeding the base of the device from a resistive voltage divider, as illustrated in figure 12.4(b). Here the effective bias source resistance is equal to the parallel combination of R_a and R_b , and may thus be made very much lower than in the fixed bias case. The appropriate forward bias is applied to the device by manipulation of both the actual values of the resistors, and their ratio.

Because it provides a closer approach to a "constant voltage" bias source, **voltage divider biasing** generally allows the effects of I_{cbo} to be made negligible. It also tends to stabilise the operating point against spread and temperature variations in beta.

It may be remembered from the preceding chapter (expression 11.5) that the input resistance of a device in the common-emitter configuration is directly proportional to beta. Because

of this, changes in beta tend to cause a corresponding change in input resistance, which interacts with the essentially constant bias voltage provided by the bias divider to produce an opposite and compensating change in the input current I_b . Hence when beta is high, I_b tends to be low, and vice-versa.

Unfortunately while voltage-divider biasing does reduce the effects of I_{cbo} and beta variation, it does not generally allow satisfactory stabilisation against V_{be} variations. In fact, the lower is made the bias source resistance in order to stabilise against I_{cbo} and beta variations, the more significant does V_{be} become in comparison with the effective bias source voltage, and the greater the effect of V_{be} variations. This illustrates the conflicting requirements for bias supply source resistance, noted earlier.

be used with either single resistor current biasing or voltage divider biasing, as shown. The current biasing variant usually provides satisfactory stabilisation with silicon transistors, particularly in low power circuitry in which the collector load is a resistor. However the voltage divider variant is preferable, especially for germanium devices, because the lower bias source resistance tends to reduce the effects of I_{cbo} and beta variations, leaving only V_{be} variations to be compensated by the negative feedback.

It should be noted with regard to self-biasing that the resistor R_b connected between base and emitter tends to produce negative feedback for "wanted" signal variations just as much as for unwanted changes in the quiescent operating point. As a result the effective gain of a device may be sig-

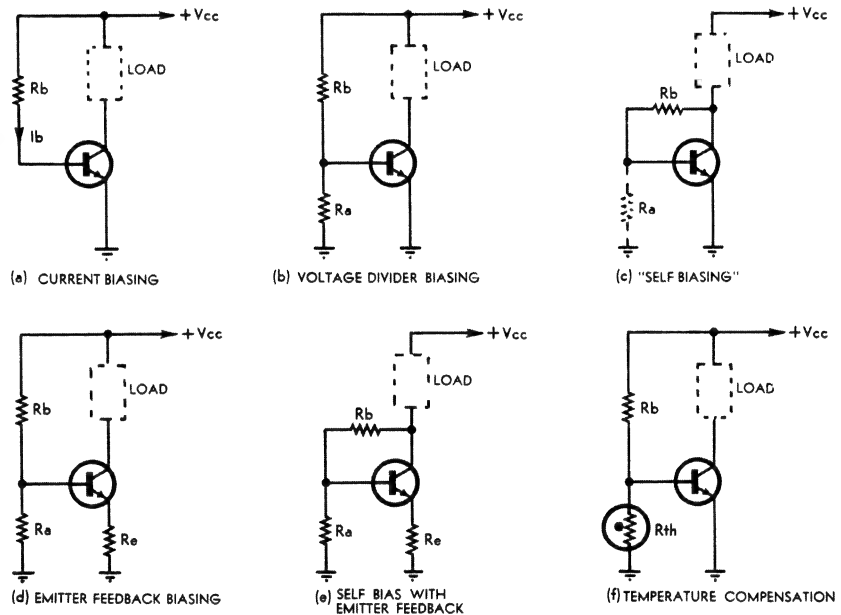


Figure 12.4

In some applications voltage divider biasing has the further disadvantage that, in order to achieve sufficiently low values of bias source resistance, the values of the divider resistors must be reduced to the point where the standing current drawn by the divider itself becomes comparable with, or can even exceed, the quiescent current of the transistor. In low-consumption battery equipment this can be very embarrassing where many stages are involved.

As mentioned earlier, negative feedback techniques may be used to overcome the conflict in bias source resistance requirements. One such method involves connection of the bias resistor R_b not to the collector supply rail V_{cc} , but direct to the collector of the device itself. This is illustrated in figure 12.4(c), being known as **self biasing**.

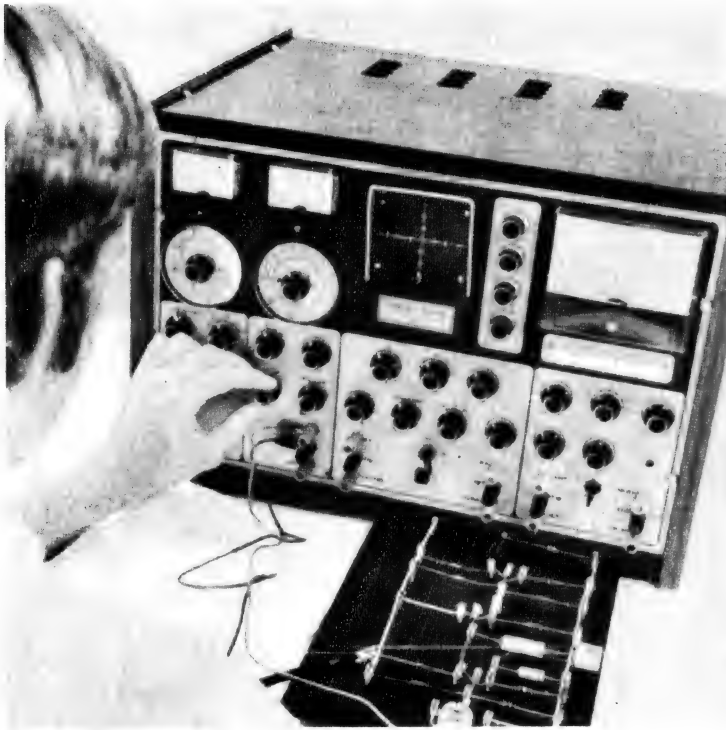
Because of the finite resistance of the load in the collector circuit, the actual collector voltage of the device normally tends to vary inversely with collector current. By taking R_b , suitably modified in value, back to the collector, this voltage change can be used to automatically vary the bias in a direction which tends to counteract any change in collector current due to I_{cbo} , V_{be} or beta variations.

The basic self-biasing technique may

significantly lowered in cases where the input signal fed to the device comes from a relatively high impedance source. To prevent this effect, R_b is often split into two series components, and the junction of the two bypassed either to ground or to the emitter by means of a suitably high-value capacitor.

A second negative feedback biasing technique, quite distinct from self-biasing, involves an additional resistor R_e connected in series with the emitter electrode. This is the **emitter feedback** technique, illustrated in figure 12.4(d).

Here the basic idea is that R_e develops a voltage drop due to the emitter current I_e , and this voltage forms an effective component of base-emitter bias whose polarity is opposite to the forward bias applied to the base. The base voltage divider is arranged to provide a higher forward bias than in the case of 12.4(b), to compensate for this "bucking" component and produce the desired nominal emitter and collector currents. However in operation any tendency for I_e to change causes the voltage drop across R_e to change accordingly, and this results in an automatic change in the effective base-emitter bias in the direction to counteract the tendency.



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It may be seen that the negative feedback effect of R_e is basically very similar to that associated with the "cathode bias" resistor of a thermionic valve, or the "self-bias" source resistor of JFETs and types A and B MOS-FETs. However the action is not exactly the same, because whereas the thermionic valve and the field effect devices just mentioned are "normally on" devices, for which biasing may often consist solely of self-regulating negative feedback, the bipolar transistor is in contrast a "normally off" device. Like the type C JFET, it must therefore always be provided with some effective forward bias, to which may be added negative feedback components for the purpose of stabilisation.

As one might expect, the effectiveness of the negative feedback provided by the emitter resistor in stabilising the quiescent operating point is almost directly proportional to the ratio between the emitter resistor voltage drop and the resultant or effective base-emitter bias. If the feedback component is large compared with the resultant bias, the feedback will be very effective; but naturally if the feedback component is relatively small compared with the resultant bias, it will only be partially effective in counteracting current changes.

Generally the feedback component cannot itself be made very large, because the voltage drop across R_e tends to reduce the available collector supply voltage and hence restrict the possible output voltage swing. To obtain effective feedback action, the forward bias applied to the base must therefore also be kept relatively low — or in other words, the base must be fed from a "voltage source" rather than a "current source." This implies either voltage divider biasing, as shown, or biasing from some other effective source of low voltage; current biasing cannot be used as this would tend to defeat the negative feedback action.

Note that the foregoing reasoning is actually identical with that given previously, in explaining why simple voltage divider biasing not only provides no control over V_{be} variations, but in fact accentuates the effect of such variations. The only difference is that in the earlier case we were seeking to reduce the influence of V_{be} , whereas in the present case we have been seeking to allow the negative feedback bias component to exercise the maximum stabilisation.

It is often found worthwhile to visualise the operation of emitter feedback biasing in terms of the effect of resistor R_e upon the effective input resistance of the transistor as seen by the base bias source. Because of the amplification action of the device, R_e will be seen by the base bias source as a resistor of value β times its actual value, connected in series with the base-emitter junction. This very high effective resistance thus tends to produce pseudo-constant current biasing, by virtually "swamping" any tendency for V_{be} to influence the base current I_b .

Because the action of the emitter feedback resistor may be visualised in this way it is often known as the "emitter swamping resistor."

Like bias resistor R_b in the self-biasing circuit, the emitter feedback resistor R_e tends to introduce negative

feedback for wanted signals just as much as for unwanted changes in the quiescent operating point. And as before, this can significantly lower the effective gain of the device. In this case the effect is not determined by the signal source impedance, however, but by the effective collector loading impedance.

The effective voltage gain in fact becomes stabilised by the negative feedback action, along with the quiescent operating point, becoming almost exactly equal to the ratio between the collector load and R_e . Hence the larger R_e is made relative to the load, the lower the effective voltage gain. In some applications this effect is deliberately used either to reduce the gain, or to stabilise the gain against parameter spread variations.

In other applications, of course, the gain reduction effect can be quite a nuisance, it being desirable to obtain full gain from the device. Happily this may be arranged simply by providing R_e with effective signal bypassing, via a suitably high-value capacitor.

The emitter feedback biasing circuit shown in figure 12.4(d) is capable of providing very stable operation with both silicon and germanium transistors,

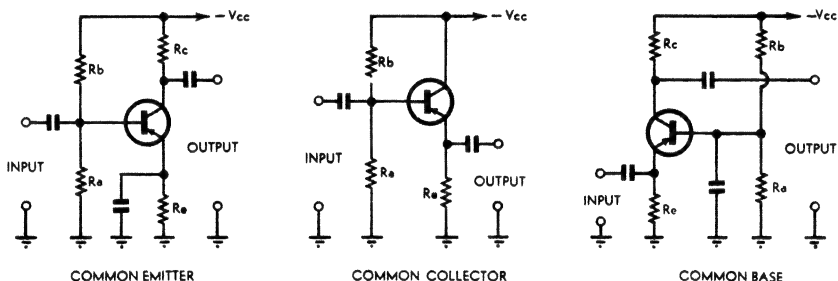


Figure 12.5

as it may be designed to compensate almost completely for variations in all three parameters I_{cbo} , V_{be} and β . For this reason it is the biasing circuit most commonly used for low and medium-power transistor circuitry.

There are cases, however, in which emitter feedback biasing alone cannot provide the desired order of operating point stability, due either to the need to stabilise over a very wide temperature range, or to the need to make compromises in setting the values of R_e and/or the bias divider resistors. In such cases it is often found worthwhile to combine the self-bias and emitter feedback techniques, as shown in figure 12.4(e). By utilising two distinct sources of negative feedback, this combination circuit is generally capable of providing excellent stabilisation.

In many transistor circuits operating at high power levels the emitter feedback biasing method cannot be used, because an emitter resistor would reduce significantly the power fed to the load. This is often unfortunate, as such circuits usually operate at elevated temperatures where a high degree of stabilisation is desirable in order to guard against thermal runaway.

As self-biasing may not always be possible in such applications due to the type of load involved, while simple voltage divider biasing may not provide adequate stabilisation, some other means of maintaining the operating point must generally be found. Often

this takes the form of a negative feedback system which monitors the temperature of the transistor, rather than its current.

Generally this approach involves the use of a device having a negative temperature coefficient, connected into the lower arm of the base bias divider, and placed in thermal contact with the transistor case. Thus, as the transistor temperature rises, the bias is automatically reduced. The temperature sensing element may be either a thermistor, as shown in figure 12.4(f), or a combination of one or more forward-biased P-N diodes. A thermistor is usually used with germanium devices, while diodes are usually used with silicon devices.

It may be noted that the biasing methods which have been discussed in the foregoing are all associated with a single transistor device, i.e., they are single-stage biasing circuits. As the reader might well have predicted, these are not the only possible biasing methods, for when devices are used in combination it becomes possible to arrange more complex biasing circuits involving direct coupling between a number of devices.

There are a great many variations

possible with such multi-stage biasing methods, in some cases exploiting either the compensating temperature variations in complementary NPN and PNP devices, or the stabilisation action provided by negative feedback around many high gain devices connected in cascade. Unfortunately space limitations do not permit further discussion of such methods in the present treatment, and interested readers must be referred to the references given at the end of this chapter.

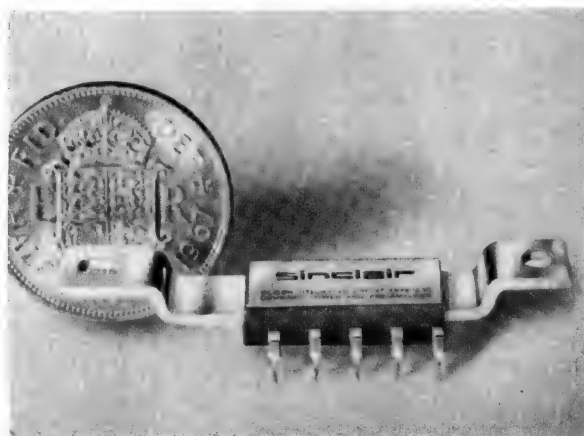
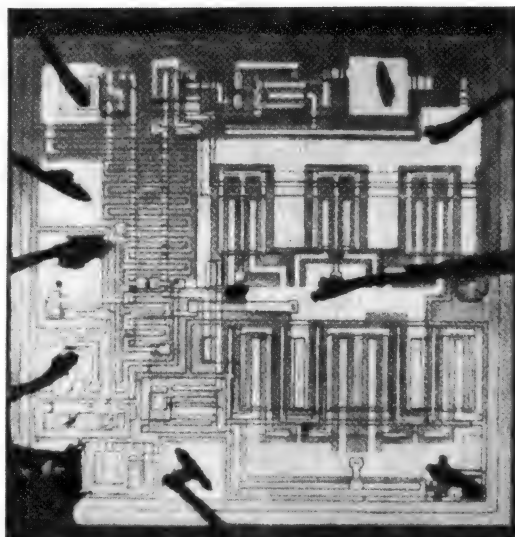
A final note which should perhaps be made before leaving the topic of bias stabilisation is that while the diagrams shown in figure 12.4 show NPN devices, this should by no means be taken to imply that any of the biasing methods described applies only to these devices. All methods apply equally to PNP devices, for which the supply polarity is simply reversed.

Having looked at the basic techniques used to bias bipolar transistors at a quiescent operating point appropriate for "linear" operation, let us now turn to examine briefly some of the very many applications of these devices in linear circuitry.

As with both field-effect devices and thermionic valves, probably the most common application of bipolar transistors is in amplifier circuits. The use of bipolar transistors in amplifier applications in fact far exceeds the use of FET devices at the time of writing, and has possibly now also exceeded that of

SINCLAIR IC-10

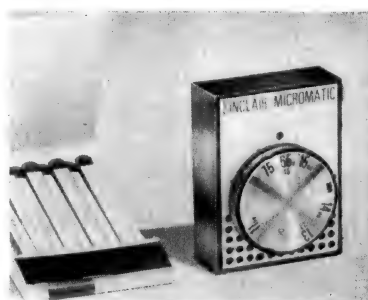
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● CIRCUIT DESCRIPTION

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● APPLICATIONS

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thermionic valves. This gives a good idea of the suitability of the bipolar transistor for many of these applications.

The variety of amplifier applications in which the devices are used is almost endless, including both small-signal and power amplifiers for audio, servo and other LF amplifiers, small-signal and power amplifiers for radio frequencies (RF), direct-current or DC amplifiers, operational amplifiers, wideband or "video" amplifiers, and instrumentation amplifiers. In almost every such application they may be used either alone or in conjunction with other devices such as FETs, and also either as a single type (NPN or PNP), or in mixed-type complementary circuitry.

Just as with FET devices and thermionic valves, bipolar amplifiers use only three basic device configurations. These are known respectively as the **common emitter**, **common collector** and **common base** configurations, and are illustrated in figure 12.5 as implemented for R-C coupled audio circuitry using PNP transistors.

The common emitter configuration may be seen to be the bipolar equivalent of the common cathode thermionic valve stage, and the FET common source configuration. The input signal is applied via a coupling capacitor to the base, while the output signal is taken via a similar coupling capacitor from the collector. Although the emitter feedback biasing method is shown, other methods may be used depending upon the specific application. Where an emitter resistor is used it is usually bypassed as shown, to prevent signal negative feedback.

This bipolar amplifier configuration provides a high order of voltage gain, useful power gain and a moderate input resistance. Typical stages may be arranged to give voltage gains in the order of 40-180 times, which compares very favourably with thermionic valve circuits. Current gain figures in the same order are also obtainable.

The input resistance of a common emitter amplifier stage consists of the input resistance of the device itself in parallel with the effective shunt resistance of the biasing network, as one might expect, and therefore tends to be somewhat lower than the input resistance of the device alone. The reader may recall from the preceding chapter that the input resistance of a bipolar transistor in the common emitter configuration depends upon its current gain and emitter current level, varying from a few ohms for a low gain power device operating at high current levels to many hundreds of kilohms for a high gain silicon device operating at very low current levels. Depending upon the device and the biasing circuit employed, therefore, a typical common emitter stage presents an input resistance of between a few ohms and a few hundred kilohms.

The output impedance of a common emitter stage is equal to the combination of the output resistance of the device itself in parallel with the collector load R_c . Generally the output resistance of the device is very much higher than R_c , however, so that in most cases the effective output impedance is almost exactly equal to R_c .

The common collector or "emitter follower" configuration is the bipolar

equivalent of the cathode follower and source follower stages. Here the input signal is applied as before to the base by means of a suitable coupling capacitor, while the output signal is taken from the emitter. The collector is connected directly to the supply rail. The emitter resistor R_e forms both the DC load resistor and the emitter feedback resistor, and as this dual function generally allows its value to be made somewhat higher than in the other configurations, the biasing stability of a common collector stage is usually excellent.

As with the corresponding thermionic valve and FET configurations, the common collector configuration provides no voltage gain but rather a slight voltage loss. However it provides a significant current gain, and also provides a very useful impedance transformation by virtue of a relatively high input resistance combined with a relatively low output impedance. Common collector stages are accordingly often used for isolation and impedance matching.

The input resistance of such a stage

silicon transistors are used. Where germanium devices must be used or where even higher values of input resistance are required, it is possible to employ special techniques such as "bootstrapping" to produce effective multiplication of the bias network resistance, at signal frequencies.

The output impedance of a common collector stage is usually quite low, being equal to the output resistance of the device itself in parallel with the emitter resistor R_e . The output resistance of the device is generally much lower than R_e , being equal to the sum of the resistance of the base-emitter junction and a fraction $1/\beta$ of the effective resistance from base to ground provided by the bias network and signal source.

It may be seen from the foregoing that the input and output impedances of a common collector stage are not independent of each other, so that such a stage does in fact behave rather like an impedance "transformer." As such it provides less isolation between input and output circuits than either of the

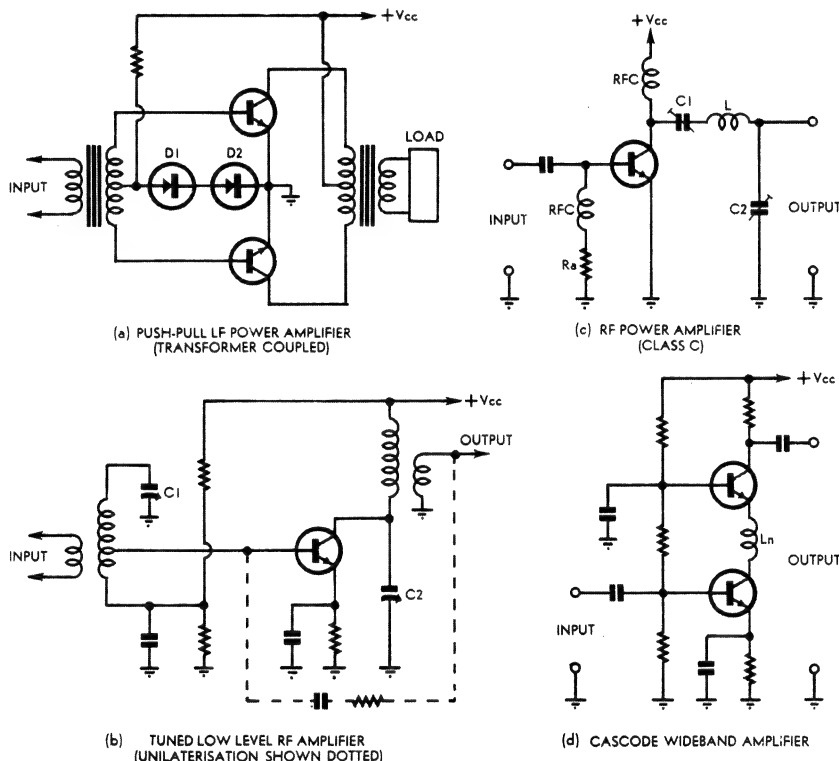


Figure 12.6

consists of the parallel combination of device and bias network resistances, as before, but in this case the input resistance of the device itself is much higher than in the common emitter configuration. It is in fact equal to beta times the sum of the base-emitter resistance of the device itself and the parallel combination of emitter resistor R_e and the following AC load.

As a result of this increase in the effective input resistance of the device itself, the effective input resistance of a common collector stage is very often determined almost completely by the bias network. And because of the excellent thermal stabilisation provided by the large emitter resistor the bias network can often be arranged to present quite a high shunt resistance — as high as two or three megohms, if

corresponding thermionic valve or FET configurations.

The common base configuration of a bipolar transistor corresponds broadly to the common gate FET stage, and to the "grounded grid" thermionic valve stage. It provides high voltage gain and a very slight current loss; however it also exhibits a very low input resistance, equal to the parallel combination of emitter resistor R_e and the base-emitter junction resistance. These characteristics make the common base configuration of limited usefulness except at very high frequencies, where it becomes of interest because of the higher cut-off frequency associated with the common-base gain factor alpha.

Low level bipolar amplifier circuitry designed for audio and other LF applications generally uses emitter feedback

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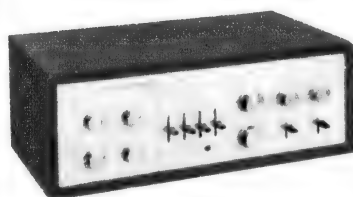
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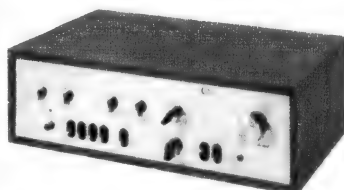
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stabilised R-C coupled stages, of the type shown in figure 12.5. However amplifiers designed for different applications may use other types of coupling, and at times some of the other types of biasing circuit. Four representative examples of other types of amplifier stage are shown in figure 12.6, to briefly illustrate some of the many variations which may be encountered.

Figure 12.6(a) shows a transformer-coupled power amplifier stage of the type used in modest audio applications, and in high power servo amplifiers. As may be seen the stage is a push-pull type, in which two transistors are used in conjunction with centre-tapped windings on the input and output transformers.

For maximum efficiency such a stage is usually biased in either class B or class AB, the latter being used mainly in audio applications where it is desirable to reduce crossover distortion. For class B operation the devices are simply operated with zero base bias, the centre-tap of the input transformer secondary being taken directly to the grounded emitters. Being "normally off" devices the transistors then automatically operate only during alternate half-cycles.

For class AB operation a small forward bias is required, sufficient to allow each transistor to conduct for part of the other's primary half-cycles. While the resultant quiescent operating points of the devices are still quite near the cut-off end of the load line, however, it is usually very desirable to ensure that operation is well stabilised. This follows because such stages often involve considerable power dissipation and temperature rise.

An emitter feedback resistor generally cannot be used, both because of the drop in efficiency which this would introduce, and because it often proves extremely difficult to effectively bypass this resistor at the very low impedance levels involved. Hence the usual bias method chosen is that of temperature compensation using either a thermistor or diodes in the lower section of the bias divider. In the diagram diodes D1 and D2 perform this function, and would normally be arranged to be in thermal contact with the transistors.

Figure 12.6(b) shows a low level RF amplifier stage of the type found in many radio receivers, and in the early stages of transmitters. As may be seen it uses a single transistor connected in common emitter mode, with tuned transformer coupling at both input and output. Capacitor C1 tunes the secondary of the input transformer to the operating frequency, while C2 similarly tunes the output transformer primary.

Typically such a stage uses emitter feedback biasing, as shown, with the emitter resistor well by-passed at signal frequency, and the base bias divider connected to the by-passed "cold" end of the input transformer secondary. Note that whereas the high output resistance of the device allows the collector generally to be connected directly to the "hot" end of the output transformer secondary, the relatively modest input resistance necessitates the base being connected to a tap on the input transformer secondary, in order to preserve the input "Q." An alternative method is for the input transformer to have a tuned primary, with the base

connected to a low impedance secondary.

It may be recalled that the bipolar transistor possesses significant collector-base capacitance: the capacitance associated with the collector junction depletion layer. This provides a potential feedback path when the device is connected in common emitter mode, so that like the triode valve and the FET, it should ideally be neutralised.

In addition, the reverse-bias leakage and saturation current I_{cbo} effectively constitutes a second "resistive" collector-base feedback component, so that

coupling capacitor, to an extent where the capacitor provides the required reverse bias. Resistor R_a is connected in series with the RFC base return to prevent the capacitor discharging significantly between charging peaks, ensuring effectively constant bias.

A further type of bipolar transistor amplifier application is shown in figure 12.6(d). This is a "cascode" amplifier stage, which like similar configurations of thermionic valves and FETs, often proves very useful in wideband amplifiers. The stage is effectively a con-

The feedback loops generally consist of R-C networks designed to provide a positive loop gain of unity at the desired operating frequency. In most cases additional circuitry is used to maintain a constant amplitude low-distortion sine-wave output, by restricting the peak-to-peak oscillations to the linear portion of the transistor load lines.

High frequency oscillators normally employ either L-C tuned circuits, quartz crystals, tuned lines or similar resonant elements. Hence in this type of oscillator circuit, the transistor is basically used as a power amplifier which compensates for the resonant element losses. It is the resonant elements which oscillate, the transistor merely ensuring that the oscillations are maintained.

Two representative examples of high frequency bipolar transistor oscillators are shown in figure 12.7. In (a) is shown an L-C tuned or "self-excited" oscillator, in which the transistor operates as a common-base amplifier with feedback coupled to the emitter from a suitable tap on the tuned collector winding. Output is taken from the oscillator by means of a low impedance secondary winding. The biasing again employs the emitter feedback method.

Figure 12.7(b) shows an oscillator using a quartz crystal "Q" as the main frequency determining element. In this case there is also an L-C tuned circuit in the transistor collector circuit, for the circuit shown is an "overtone" type in which the crystal is forced to operate in a higher-order mode than the fundamental. The idea is that the collector tuned circuit is adjusted so that the transistor is only able to provide the loop gain necessary for maintaining oscillations at the desired crystal overtone. Hence it is at this overtone that oscillations occur, rather than at the fundamental or other overtone frequencies.

As may be seen the bias used is again of the emitter feedback type, while the output is again taken via a small winding coupled to the inductor of the collector tuned circuit.

There are many other applications of bipolar transistors in linear circuitry, in addition to amplifier and oscillator applications. Bipolar devices are used as detectors, mixers, harmonic generators and frequency multipliers, and also as controlled-value resistor elements in applications such as automatic gain control (AGC), modulators, series and shunt voltage regulators, and current regulators. Unfortunately space restrictions prevent more than a brief acknowledgment here of the existence of these applications, however, and interested readers must be referred to references such as those listed below.

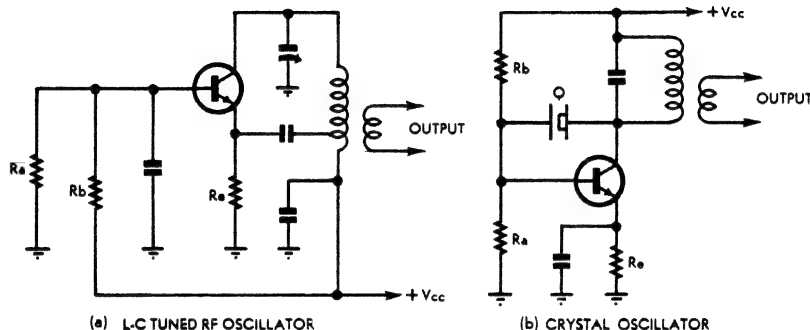


Figure 12.7

for fully stable operation at high frequencies a bipolar transistor must strictly be **unilateralised**. This term means nothing more than the effective conversion of the transistor into an ideal "one-way" device, by neutralisation of both the capacitive and resistive feedback components.

Generally both neutralisation and the more complete unilateralisation can only be applied to fixed-frequency amplifier stages, as found in such applications as receiver IF stages and many low-power transmitter stages. Where the stage involved is tuned over a significant frequency range, it proves difficult to maintain constant compensation for the internal device feedback, and other techniques such as controlled mismatch must be used. One method of unilateralisation used for receiver IF stages consists of a series R-C combination, connected as shown in dashed form in the diagram.

An RF power amplifier stage of the type found in recent low power VHF transmitters is shown in basic form in figure 12.6(c). This type of stage generally employs special devices designed to provide useful power gain at many hundreds of Megahertz. The device usually operates in class C, conducting only on the tips of alternate half-cycles; the resulting collector current pulses are applied to a tuned circuit which then produces a smooth sine-wave output by "flywheel" action.

In the type of stage illustrated the collector tuned circuit may not be immediately recognisable, consisting of inductor L and capacitors C1 and C2. It is basically a series resonant circuit, arranged in the form shown to act also as an impedance matching network and harmonic filter.

The reverse bias necessary to operate the device in class C may be applied either from a suitable bias supply, or by means of a "signal derived" bias system as shown. Here the conduction of the base-emitter junction of the device on signal peaks charges the input

combination of a common emitter stage and a common base stage, with the common emitter stage providing relatively high input resistance and significant current gain, while the common base stage provides high voltage gain with wide bandwidth.

Although a cascode stage may consist of two devices with R-C coupling between, it is often possible to connect the two directly as shown and thus save components. The inductor L_n is a stabilising element often found necessary to prevent oscillation due to interaction between the collector and emitter impedances of the two devices at high frequencies.

Being capable of power amplification, bipolar transistors are naturally quite suitable for use in oscillator circuits. In fact they find use in oscillators generating signals spanning almost the full range electromagnetic frequency spectrum to which electronic circuitry is currently applied — from a small fraction of a Hertz to many Gigahertz (GHz).

At low and medium frequencies bipolar transistor oscillator circuits generally consist basically of R-C coupled amplifiers, either single stage or multi-stage, around which feedback loops are connected. The circuitry thus involves transistors connected in a manner usually very similar to that shown in the diagrams of figure 12.5.

SUGGESTED FURTHER READING

- BRAZEE, J. G., *Semiconductor and Tube Electronics*, 1968. Holt, Rinehart and Winston, Inc., New York.
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- CLEARY, J. F., (Ed.) *General Electric Transistor Manual*, 7th Edition, 1964. General Electric Company, Syracuse, New York.
- WALSTON, J. A., and MILLER, J. R. (Eds.) *Transistor Circuit Design*, 1963. McGraw-Hill Book Company, Inc., New York.
- WOLFENDALE, E., *Transistor Circuit Design and Analysis*, 1966. Heywood Books, London.



FORUM

X-rays from TV sets — Australian tests

Last month we referred to an article in "The Australian" newspaper about the allegedly dangerous level of X-ray type radiation from television receivers. We expressed strong reservations about the validity of the statements and, this month, our view is supported by a letter from the Department of Public Health in New South Wales.

Conducted by the Editor

The article in "The Australian," written by Phillip Adams, was based on findings by an American scientist, John Ash Nott.

Nott reported that rats, caged in front of either a monochrome or a colour television receiver, sickened and died from what he assumed to be the effects of X-ray radiation.

The article went on to complain, in effect, that the major media had deliberately suppressed Nott's findings, leaving it to the "underground" press to publish them and to reveal other relevant matters, such as the recall of colour receivers in the U.S.A. known to radiate X-rays.

We pointed out that Nott's report was at complete variance with the majority findings and that investigators generally had not been able to measure significant radiation from monochrome receivers, using the most sensitive detection equipment available.

Further, that the subject of radiation from colour television receivers had been freely discussed in the technical press, the world around. If the major news media did not splash it over their front pages, it was not a matter of suppression; rather, it was simply not big enough news, in their opinion, to warrant such coverage. The electronics industry had discerned a problem and taken corrective measures before any apparent harm had been done.

We went on to suggest that Nott's unfortunate rats had suffered, not from X-ray radiation but from the (for them) intense sonic output from the line deflection components.

As far as we were concerned, the "underground press," whatever that means, was welcome to the story!

Having expressed ourselves thus, we were most interested to receive a letter from the Department of Public Health (N.S.W.) over the signature of Mr H. M. Whaithe, Officer-in-charge of the Radiation Branch. The letter runs as follows:

Dear Sir,

I was interested to read your comments in the April issue of "Elec-

tronics Australia" on an article which recently appeared in a daily newspaper. It concerned radiation hazards from television receivers and, in my opinion, you have analysed the subject matter very effectively.

A Sydney woman wrote to us after reading this article, and my reply, which may be of some interest to your readers, confirms your conclusions.

"Dear Madam,

In reply to your letter of 23rd February concerning radiation hazards from television sets, we have measured radiation dosages from a number of black-and-white television sets and have found them to be negligible.

We have not measured radiation dosages from many colour television sets in this State, since they are few in number and mainly used in experimental work. However, American experience is that the main hazard arises from what is known as the shunt regulator tube, when operated at voltages over 25,000 volts. Black-and-white television sets operate at a maximum of 17,000 volts, and do not employ a shunt regulator tube, hence their comparative freedom from radiation emission.

Remedies suggested in America have involved modification of the shunt regulator tube and checking of the alignment of its internal components. Shielding of the tube so as to absorb its radiation is a simple precaution.

The commonly accepted limit of

dosage rate is 0.5 milliroentgen per hour at 5 centimetres (2 inches) from the outer surface of any home television receiver. Even if one needed to approach this closely to the surface, it would be permissible to remain there for 20 hours per week to receive the 10 milliroentgens per week permitted to members of the general public. In fact, by sitting at a distance of even a couple of feet, this dosage would be reduced considerably, and is normally much less than that received from "background" radiation.

Some tests carried out in the United States showed that, over a small area, the radiation beam at a distance of seven inches below the shunt regulator tube was up to 8,000 milliroentgens per hour. On this basis, a hand placed under the set would receive a week's dosage allowance (1,500 milliroentgens) in less than 10 minutes. It is, of course, unlikely that a hand would be so exposed, but there is a potential hazard, and it was found possible, by slightly modifying the tube, to reduce this dosage to a negligible amount."

Finally, I might mention that some consideration is currently being given to the production of a national "Code of Practice" covering the emission of radiation from colour television receivers. Its purpose will be to ensure that manufacturers virtually eliminate stray radiation from these sets, and thereby avoid the debacle which occurred in the United States and Canada where, as stated, a large number was withdrawn from service.

Yours faithfully,
H. M. Whaithe.

By coincidence, during the month, we received notice of an international symposium on the subject: "Radiological Protection Problems Associated with Parasitic X-ray Emission from Electronics Products."

The symposium is to be conducted by The Centre of Atomic and Nuclear Physics of the Faculty of Science of the University of Toulouse. The date: November 3-6, 1970. Those requiring further information may write to:

Mr E. A. Hampe,
Commission of the
European Communities,
Directorate-General
for Social Affairs,
Directorate for
Health and Safety,
29 rue Aldringer,
LUXEMBOURG
(G.D. of Luxembourg).

According to the literature, the aim of the Symposium is: "To enable electronics engineers, technical inspection bodies, public health and occupational-safety authorities to carry out ex-



"X-rays or no x-rays, I reckon TV is a time waster." (TV Times)

SOUTH COAST GHOST PROBLEM

Dear Sir,

Attached please find a photograph of the top of the mast erected on "Nanny Goat Hill" Cooma from the A.B.C. translator Channel "0" to serve the town of Cooma.

The translator re-transmits from ABSN-8 (Cooma-Bega) at Brown Mountain, near Nimmitabel, N.S.W.

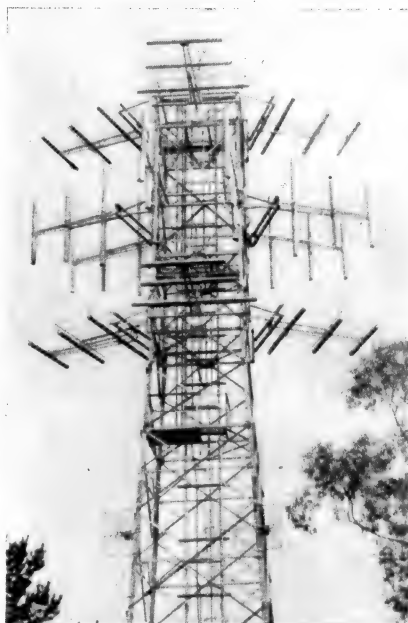
The translator at Cooma, which came into operation in October, 1969 is unique in Australia in that it transmits on both vertical and horizontal polarisation.

The parent station uses vertical polarisation but it was found that the signal on Channel 8 was prone to severe ghosting due to the hills which surround Cooma.

The translator was designed so that householders who already had vertical antennas could use them for the translator, or new installations could be made using horizontal equipment which was less prone to ghosting.

The sidelight on the installation was that, following recriminations between the local trade and the Broadcasting Control Board (See Electronics Australia, May 1967, Pages 88-92), in which it had been suggested that the problem with ABSN-8 was the receiving antennas and installations and not the transmitter, the P.M.G. had difficulty obtaining a ghost-free picture at Nanny Goat Hill from Brown Mountain.

Eventually the problem was largely



overcome by the purchase from a local retailer of a phased array which is now mounted above the P.M.G.'s Tower — the same type of antenna as sold by the trade in Cooma for several years.

C. C. Maher (Development Officer,
Cooma Visitors Centre.)

changes of views and experience on this subject so that they can draw up an inventory of the radiological protection problems and seek for suitable technical and administrative solutions."

The provisional agenda includes the following items:

- Possible sources of parasitic X-rays, and experimental results;
- Methods of measuring soft X-ray emission;
- Biological aspects of exposure to soft X-rays;
- Means of reducing parasitic X-ray emission;
- Performance standards, testing and inspection methods for electronic products.

Included in the above will be a discussion of the problems associated with parasitic X-ray emission from electronic products such as rectifying valves, transmitting valves, thyatrons, klystrons, magnetrons, electron microscopes and television receivers.

Well, there it is for those who want to follow up the subject further. A trip to Toulouse might also be just the thing for:

- Feature writers seeking new scare material;
- Businessmen seeking a tax deduction;
- Public servants seeking to do their duty.

Pity it had to be November, though! Changing the subject, we have a letter from a reader in Numurkah, Victoria, who has this to say:

Dear Sir,

An experience in importing from Hong Kong may be of interest to your readers.

I.E.C. Hong Kong advertised in the "Electronics Australia" September, 1969 issue. I wrote for a catalogue which duly arrived. It was perused at work by members of my staff.

One of them ordered three transistor-6 kits at a cost totalling about \$10. When the kits arrived, there was a custom duty owing of \$44. When I queried customs, I was informed that the import duty on radios, or on kits which were classified as complete radios, was 45 per cent plus \$10 per set.

I have another brochure from a party in Brisbane where, if I pay \$10, he will tell me how to import direct from Hong Kong at fantastically cheap prices.

What I would like to know in the import game is who cons whom, as these same radios can be bought in any radio shop for about \$10, which includes profit margins plus 25 per cent sales tax. Customs must be a very flexible organisation.

Unfortunately, my staff member has kissed his \$10 goodbye and put it down to experience. He has the consolation that he might as easily have ordered a hundred kits instead of just three!

T.C. (Numurkah, Vic.)

When this letter came to hand, I had to search through the September issue to find the advertisement mentioned. It turned out to be a small insertion in the classified section, which explains why it had passed unnoticed. However, there is no suggestion that it is any-

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VF-3100E \$24.50.

"Extract" Comment from "Electronics Australia" (Page 119, February, 1969) "frequency response checked out at plus or minus 2dB. from 30Hz. to 20 kHz... a very good performance indeed."

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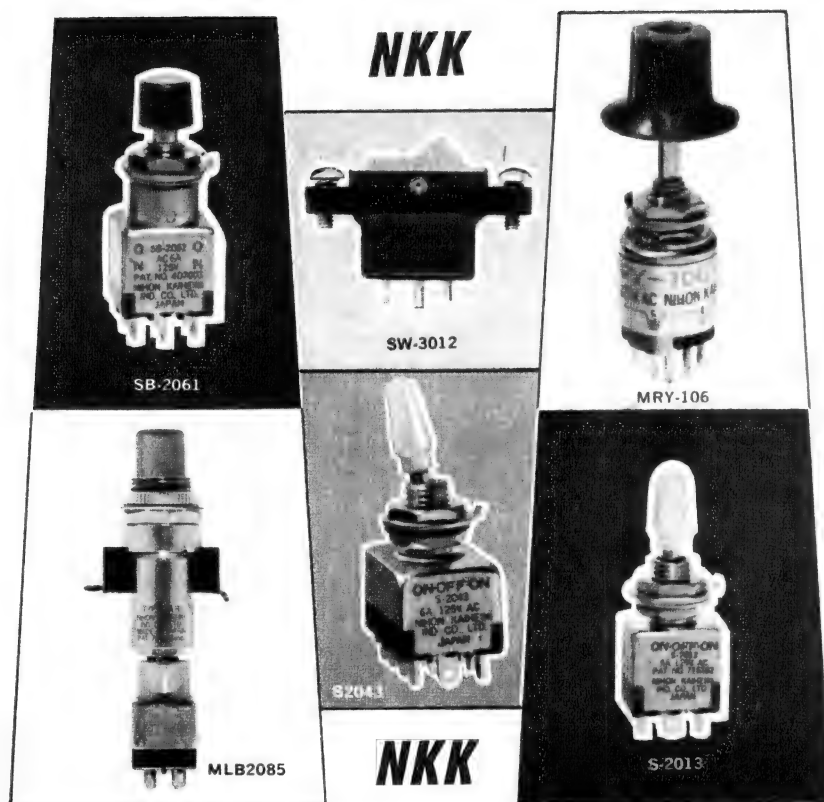
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TOGGLE	S-2012	SPDT	5A	ON-ON
	S-2013	SPDT	2A	ON-OFF-ON
	S-2022	DPDT	5A	ON-ON
	S-2023	DPDT	3A	ON-OFF-ON
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thing but a perfectly legitimate advertisement from a firm interested in exporting electronic components.

And, indeed, there is no doubt that electronic components are available from overseas sources at what are, to us, very cheap prices. Would you believe IF transformers for less than 10 cents apiece? A complete IF assembly, needing only input output and supply leads for about \$1.50? Crystals, ground to order, for less than \$2?

Six-transistor receivers, being cleared through the shops on Hollywood Boulevard for \$3.99?

These are things that I happen to have seen personally, or otherwise run across during the past couple of years. Those fortunate to be sharing in our "Technitour" during June-July, will probably be able to note at first hand the price levels of equipment emerging from factories in Taiwan.

In Australia, as in many other countries, we are isolated from such price levels by tariff and other barriers. This is exasperating for the hobbyist and the professional importer alike but it would appear to be an essential measure if we are to preserve our industry and our standards of living. (This could lead to a long argument, of course, which it is not for us to pursue here.)

The basic fact is that, whether we like it or not, customs duties do operate in relation to a wide range of imports and they have to be taken into account.

People travelling overseas are well advised to find out beforehand what they can take into countries which they propose to visit and what they can bring back into their own, when they return.

In exactly the same way, anyone seeking to import items, whether as freight or through the post, should check on the customs situation beforehand, to see whether the proposed transaction is worthwhile. By no stretch of imagination is it the responsibility of the exporter, who is concerned only with obligations to his own country.

The young man referred to in the letter certainly learned the hard way. It is unfortunate that he did not stop to think that customs duties might be involved when importing items from Hong Kong. It is equally unfortunate that no one else apparently bothered to mention it to him.

Radio and television receivers, either built up or in kit form, face a stiff customs barrier. For decades, the manufacture of these items has formed the backbone of our electronics industry, which makes very certain that the Government does not lose sight of the fact. But protection notwithstanding, local manufacturers still cannot compete effectively with some of the imported products.

T.G. says that "these same radios can be bought in any radio shop for about \$10" — this presumably in Australia. All I can say is that I haven't seen them at anything like this price.

Undoubtedly, private individuals do manage to bring in a few electronic components, through the mail and in small quantities. They score from the fact that it is neither economical nor possible to inspect every letter or every small package addressed to private individuals. Even if it were, it would be far too tedious to calculate and collect a few cents here and a few cents there.

As for the man in Brisbane, I

wouldn't have a clue as to what information he might be offering for \$10. It may be very useful and perfectly legitimate information about the range of goods which can be imported, either duty-free or at an attractively low rate of duty. It may or may not include electronic components.

However, details aside, the letter from T.C. will undoubtedly have fulfilled the writer's intention — alerting readers to the fact that bargains from Hong Kong may turn out to be anything but bargains if they are subject to high import duties.

Colour television

During early April, there were some raised eyebrows when the "Sydney Morning Herald" carried a story by Ian Evans about a Sydney viewer watching certain television programs in full colour. At first glance it looked like an April leg-pull but it wasn't.

The person mentioned in the story was Mr Victor Barker, a licensed radio amateur, and a technician on the staff of ATN Channel 7 in Sydney. Prior to coming to Australia, he had gained experience in colour television and had on hand a colour television receiver designed for the PAL system.

When ATN 7 (and doubtless other stations) began putting to air original colour tapes of overseas shows, Vic Barker realised that the tapes would necessarily contain the original chrominance signals. Certainly, the station's normal pulse shapers would shave off the reference bursts for the colour sub-carrier but if, by any other means, the carrier supplied by the receiver could be maintained in suitable phase relationship with the chrominance sidebands, the colour information could be decoded and used in the normal way.

Having an idle colour receiver on hand was three-quarters of the battle but full marks must nevertheless go to Vic Barker for waking up to the presence of the "accidental" colour signals and for devising circuitry which would provide a suitable sub-carrier.

However, his accomplishment must necessarily fall short of the "genius" rating which was implicit in the "Sydney Morning Herald" article.

Station engineers and The Australian Broadcasting Control Board were fully aware that chrominance signals interleaved in the video information would ride through on a normal monochrome transmission, even if a trifle mangled by the less stringent performance standards of monochrome equipment. They had presumably relied on the fact that: (a) The chrominance signals would not be noticed on monochrome receivers and (b) the signals could not be used, anyway, in the absence of a reference burst on the "back porch" of the sync. pulse.

This last assumption was not entirely valid, as Vic Barker has demonstrated, and as reference to the literature would have shown.

It would appear that the early sponsors of the PAL system regarded the reference burst as a desirable feature and one that, in general, would simplify the design of PAL colour television equipment. However, for situations where phase relationships had become suspect, they foresaw an advantage in downgrading reliance on the reference burst and relating the

carrier re-insertion oscillator more to the actual chrominance signals.

This was the concept behind the so-called "Perfect PAL" receiver.

We haven't attempted to trace the bibliography on the subject but one article which happened to be in our files was in the "NTZ Communications Journal," Volume 3/1964, Number 6. Translated from the rather forbidding German form, this journal is the "Proceedings of the Communications Group within the German Electrical Engineering Association." The article was entitled: "The PAL Colour TV System — Basic Principles of Modulation and Demodulation."

But, quite apart from possible arguments about who first thought of what, the Herald article may well have stirred up something of a political hornets' nest. Now that they have been alerted, any engineer who has access to a developmental PAL receiver can fairly obviously contrive the extra circuitry and make use of chrominance information, when available in what are ostensibly monochrome transmissions.

I can't imagine that this prospect will make the Australian Broadcasting Control Board very happy, because they have presented a very stern face, to date, to the radiation of unauthorised colour information.

But, on the other hand, what do the stations do when the most practical form for some imported programs is a video tape with the chrominance information inextricably interwoven with the higher frequency video?

Are the stations to lop the whole lot off and offer, as a result, a degraded monochrome picture?

Or will they be required to negotiate for tapes or kinescopes deliberately prepared without the vital colour information — assuming that these exist?

Or are we getting so close to the colour era that the ABCB will ignore what is a purely temporary problem?

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The AUTODRUM

In this article we introduce another electronic percussion instrument which we have named the Autodrum. As in the case of the Electronic Bongos featured last month, it is based on the twin-T oscillator. In addition to being keyed manually, it has the facility of automatic triggering at any desired rate.

By LEO SIMPSON

Essential to almost any small musical "combo" is a rhythm section, consisting, usually of snare and bass drums and a set of high-hat cymbals. The instrument we describe in this article could conceivably replace the bulky bass drum. It is accommodated in a small diecast metal box so that it can be carried in a briefcase instead of a station wagon. As with the bass drum it can be pedal operated but it has the additional facility that it can be automatically keyed at any desired rate.

Alternatively, the Autodrum could be used to accompany a solo piano or electronic organ. With a powerful amplifier and loudspeaker to match, it puts out a beat that anyone could follow. Use it over the school P.A. system and it will make those lazy schoolboys look like automations. Lastly, if you listen to it for half an hour, as the author did when developing it, it will give you a headache!

The bass drum is synthesised by the same method as described in the article on the Electronic Bongos, referred to

above. We set up an electrical analogue: a circuit which "resonates," or produces a wave-train when an electrical impulse is applied to it, the electrical impulse being analogous to the physical blow applied to a drum. The circuit also requires a means of determining the damping of the resonance, so that the "quality" of the resonance can be altered to simulate that from the acoustic instrument.

A circuit which lends itself to synthesising percussion instruments is the Twin-T oscillator, so-named because of the configuration of the twin RC phase-shift networks. In this particular instrument, the oscillator is set into the "quiescent" mode, i.e., just on the point of oscillation, with the aid of a 25K potentiometer in the emitter load of the transistor. An electrical impulse applied to the junction of either of the T-networks or to the base of the transistor will shock the circuit into brief oscillation. The degree to which the oscillation is sustained will depend on the setting of the potentiometer.

If the potentiometer is set for max-

imum resistance, the oscillation will be very short — only a few cycles. If the potentiometer is set so that the oscillator is just into the quiescent region, the oscillation will be quite long, probably 20 or more cycles. Beyond this again, the stage will go into full oscillation, which would be totally undesirable for the present purpose.

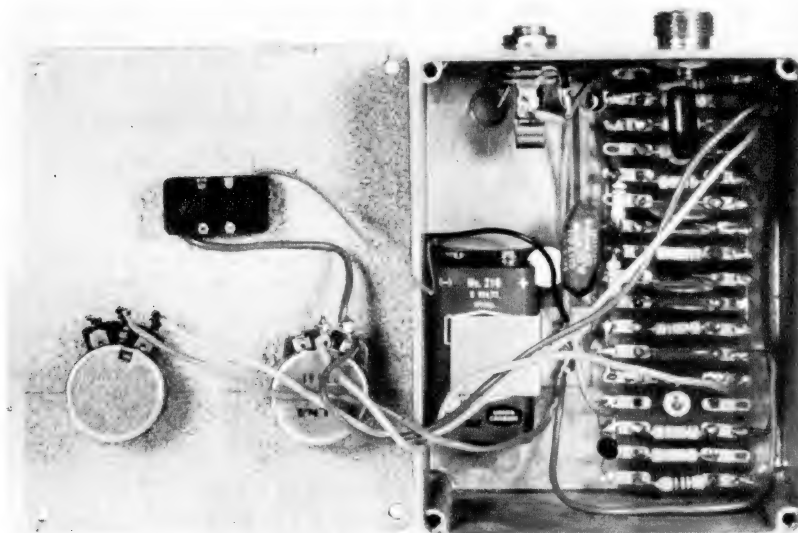
The waveforms shown in figure 1 illustrate the three possible modes of oscillation possible with the Twin-T oscillator. Figure 1(a) shows a continuous oscillation at constant amplitude. Figure 1(b) shows a lightly damped oscillation produced with the oscillator set just into the "quiescent" zone. Figure 1(c) shows a heavily damped oscillation produced with the potentiometer set for a very short "sustain."

The circuit may be triggered into oscillation by the same method as used in the Electronic Bongos, i.e., with the aid of touch plates connected to the junction of one of the T-networks. However, since a bass drum is usually pedal-operated, we have suggested a different method. The circuit is triggered into oscillation by a DC pulse into one of the T-networks. This can be initiated either with a pedal-operated switch or with the auxiliary triggering oscillator which we have incorporated.

The triggering circuit is a relaxation oscillator featuring a three-terminal PNP device from General Electric which is called a "programmable unijunction transistor" (PUT) with the type number D13T1. The theory of PUT operation was discussed in the article, "Keeping up with Semiconductors" in the December, 1968, issue.

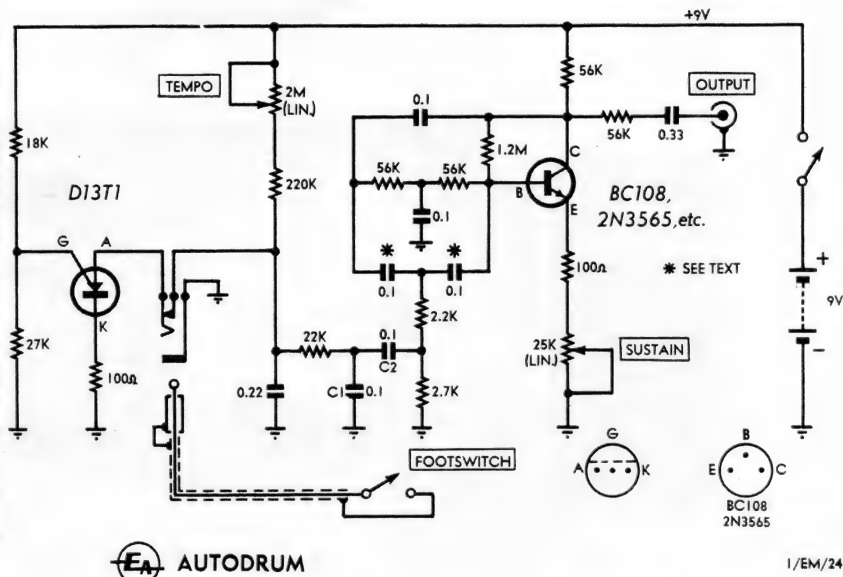
In actual fact, the PUT is closer in mode of operation to a thyristor than to a conventional unijunction transistor. For the purpose of this article it will suffice to know that the PUT can be arranged to function as a relaxation oscillator, as one of its many possible applications. The three terminals of the PUT are designed as Anode, Anode Gate and Cathode (A, G, and K).

There is no reason why the reader should not experiment with a triggering circuit using a conventional UJT, although there may be some problems in achieving the desired low repetition rates. For our part, the other good reason for using the PUT is that it is



A view of the layout inside the case of the Autodrum. As viewed here, the Sustain control is on the left and the Tempo control on the right. Above them is the On/Off switch. At the extreme top right is the output connector and, alongside it, the jack for individual triggering.

The repetition rate of the PUT oscillator shown ranges from 50 beats per minute to over 220 beats per minute, which should be more than ade-



The circuit diagram of the Autodrum. It uses a twin-T oscillator to produce the "drum" sound and a PUT pulse generator to provide the automatic repeat feature.

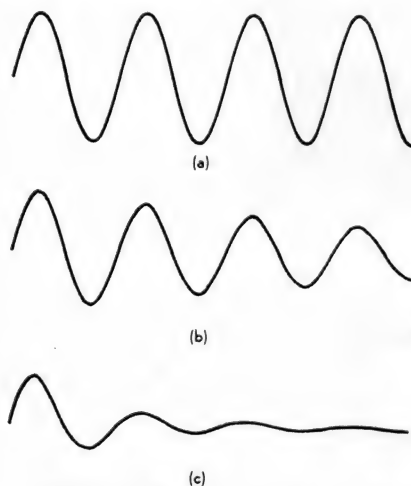


Figure 1

The above waveforms show the three modes of oscillation possible with a Twin-T oscillator. (a) is continuous; (b) is lightly damped and (c) is heavily damped.

The Autodrum could be arranged to simulate the Tom-tom by changing the 0.1uF capacitors on the circuit diagram marked with an asterisk to 0.047uF.

When drilling the diecast box, use a sharp drill at high speed and a low rate

The Autodrum could even be triggered by using the hand to interrupt a light beam which actuates an LDR/

PARTS LIST

- 1 Diecast utility box, 4-5/8 x 3-5/8 x 2 inches.
 - 1 push on-push off switch.
 - 1 phone jack socket.
 - 1 17-lug tagboard.
 - 1 output socket.
 - 1 battery (Eveready 216 or equivalent) and connector to suit.
 - 1 25K (1in) potentiometer.
 - 1 2M (1in) potentiometer.
 - 1 BC108, 2N3565 or equivalent silicon NPN transistor.
 - 1 D13T1 programmable unijunction transistor.
- (Note: The General Electric D13T1 can be obtained direct from Messrs Watkin Wynne Pty. Ltd., 32 Falcon Street, Crow's

- Nest, 2065, or from most kitset suppliers.)*

CAPACITORS

(Voltage ratings higher than 9V will suffice)
1 x 0.33uF, 1 x 0.22uF, 6 x 0.1uF,
all ceramic or polyester.

RESISTORS

($\frac{1}{2}$ or $\frac{1}{4}$ watt rating)
1 x 1.2M, 1 x 220K, 4 x 56K,
1 x 27K, 1 x 22K, 1 x 18K, 1 x
2.7K, 1 x 2.2K, 2 x 100 ohms.

SUNDRIES

2 knobs, footswitch (see text), screws, nuts, battery clamp, hookup wire, solder, etc.



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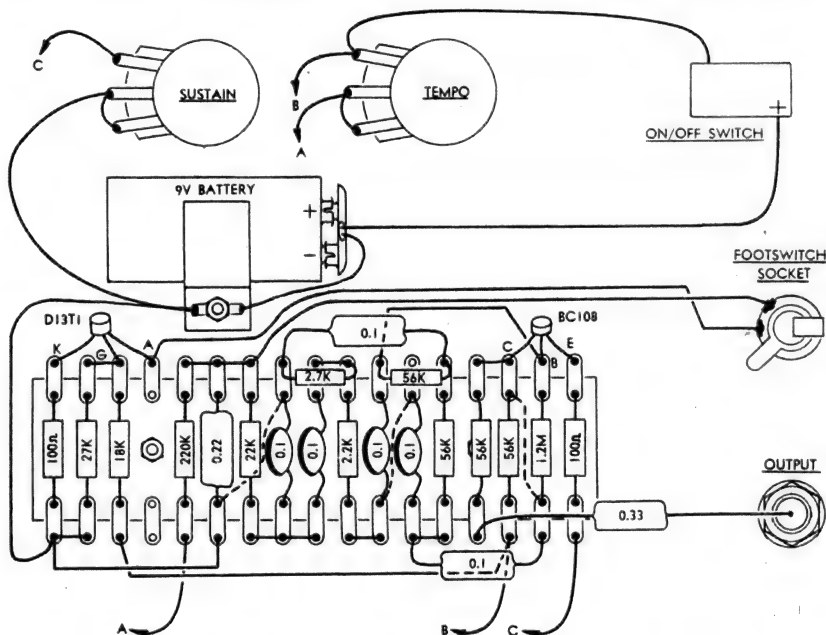
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DIAGRAM SHOWS COMPONENTS AND WIRING



The assembly of the Autodrum will be a straightforward process if this wiring diagram is followed closely.

relay combination, this would introduce an element of "mystery" into its operation though it will also introduce a substantial degree of complication.

When assembly is completed, connect the Autodrum to an amplifier and loudspeaker. Switch on and turn the sustain control fully clockwise. The drum oscillator should be operating continuously at about 60Hz. Now rotate the sustain control anticlockwise until the oscillator just stops. Varying the Tempo control will now control the rate at which the Autodrum beats. Critical adjustment of the Sustain con-

trol will make the Autrodrum sound like Bass drum or a kettle drum.

Finally, a word to avoid experimenters on how the basic circuit described here could be expanded to make a simple rhythm generator. Two Twin-T oscillators would be needed, each one having an associated relaxation oscillator to trigger it. One relaxation oscillator would be run from the output of the other relaxation oscillator, so that it acts as a frequency divider. One relaxation oscillator would provide the basic beat while the other provides the accented beat, on a different note.

Addendum to Electronic Bongos

The article on the Electronic Bongos in last month's issue of "Electronics Australia" has apparently created much interest among readers, two of whom have suggested worthwhile modifications.

The first of these was submitted by Mr K. H. Young, of Nunawading, Victoria, concerns the hand-held probe to which is connected the positive supply line. As an alternative, a third touch plate is installed between the existing two plates. The third plate is connected to the positive supply and the 22K probe resistor may be omitted. In playing the Bongos, the thumb of one hand would rest permanently on the centre touch plate while the fingers tapped the oscillator plates in the normal way.

The second modification was suggested by a reader during a telephone conversation and unfortunately, he did not give his name so that we could acknowledge it. His suggestion involves the use of a stereo amplifier and associated loudspeaker systems. Instead of mixing the two oscillator signals together via 22K resistors, each oscillator signal is coupled individually via a 22K resistor and 0.1uF capacitor to

each channel of the stereo amplifier. In this way, the subjective level of each "drum" can be adjusted for equal intensity with the aid of the balance control.

If the amplifier had separate tone controls for each channel, this would enable further adjustment to obtain the best effect from each "drum." ■

NOTES AND ERRATA

INTRODUCTION TO DIGITAL FREQUENCY METERS (February, 1970): In figure 5(a), on page 49, the connections to the J and K gating inputs of elements FF2 and FF4 were both shown incorrectly transposed. In both cases the connections should be reversed.

27MHz IC SUPERHETERODYNE RECEIVER (February, 1970). In the wiring diagram (page 61) the transistor numbers, T1 and T2 are reversed. Fortunately, it has no technical significance as both transistors are of the same type. Both transistors are fitted with a fourth "shield" lead, which should be connected as shown in the wiring diagram. ■

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THE DEVELOPMENT OF

This article may be regarded as a sequel to "The Development of Systeme Internationale" which we presented in the April issue, since it deals with the closely related subject of reference standards. Although there is a certain amount of overlap between the two articles, to preserve the continuity of the text we have not attempted to delete this material.

By L. C. Debnam

One of the greatest problems which arises when communicating information is to find a common basis to which to refer. The Hieroglyphic writing of the ancient Egyptians was undecipherable until the discovery of the Rosetta stone in 1799, on which the same text was written in Hieroglyphic, Demotic and Greek, and as Greek was known this acted as a common basis to aid the translation of the Hieroglyphics.

Similarly common bases of measurement are required if technology is to advance, and chaos would reign if each manufacturer used his own system of units for measurement.

At various periods in history attempts have been made to obtain standards of measurement, but it was not until the latter half of the eighteenth century that concerted efforts were made to devise standards by which all physical quantities may be measured. This first "total standards" system was devised at the time of the French revolution. In 1790 the French National Assembly appointed a committee for the purpose, and the metric system was initiated by the Paris Academy of Sciences in 1791.

The most important measurement to be initially standardise was the measurement of length. This was to be based on the distance along the surface of the Earth from the equator to the North Pole, this distance to be 10 million "metres." It was known from astronomical measurements that the distance between Barcelona (in Spain) and Dunkerque (in France) was a little more than one tenth of the distance of the North Pole from the equator, so between 1792 and 1799 this distance was surveyed under the direction of Jean Baptiste Delambre. The surveyed distance was divided by 1075,039 and this length, the metre, was inscribed on a bar for easy reference. Unfortunately, due to surveying errors the metre is not exactly one ten-millionth of a quadrant of the Earth's meridian as originally proposed.

The unit of length was then used to define the unit of mass, and one kilogram was defined as the mass of 1,000 cubic centimetres of water at its maximum density (4°C). The volume, 1000cc, was called the litre.

From these units of length, volume and mass the metric system of measurement started, and during the first quarter of the nineteenth century was adopted by Italy, Belgium and Holland. In the 1860s it became legal to use the metric system in the British Empire and the United States. There was no unit of time in the original metric system but for centuries astronomers had used 1/86,400 of the mean solar day as "one second" and this was in general use throughout the world.

The unit of temperature, the degree Celsius (also known in English as the degree Centigrade), was originally proposed in 1742 by Anders Celsius of Sweden as one-hundredth of the temperature difference between melting ice and boiling water, although in Celsius' original system ice was at 100° and boiling water at 0°. It is not generally known that the Fahrenheit temperature scale (named after the German Gabriel Daniel Fahrenheit, 1686-1736) is also based on the fraction 1/100, with "zero" being the lowest temperature obtainable with a mixture of ice and salt, and "100" being the temperature of the human body.

Due to dissatisfaction with the original definitions of the metre and kilogram, and the need for standards in other measurements, the French Government arranged a conference in 1870 to determine standards for a unified measurement system, and in 1875 a number of countries signed the "Treaty of the Metre." This treaty established the Inter-

national Bureau of Weights and Measures (Comite International des Poids et Mesures) and the General Conference on Weights and Measures (Conference Generale des Poids et Mesures). The International Bureau of Weights and Measures is the custodian of the standards for measurement agreed upon at periodic meetings of the General Conference.

At the first General Conference the metre and kilogram were adopted as units of length and mass, the second (as 1/86,400 of the mean solar day) was adopted as the unit of time and the degree Celsius for temperature measurements. These units, along with the Ampere (for electric current) and the Candela (for light intensity) are the six main units adopted by the General Conference on Weights and Measures, but the methods of determining these units have changed considerably since the first Conference.

The measurement of time was accepted as a fraction of the mean solar day until it became apparent from the use of quartz-crystal controlled clocks that variations in the length of the day were greater than had been assumed, varying as much as one part in 10 million, or three seconds per year. Even averaging the day throughout the year was found to be unsatisfactory as the length of each year was found to vary. In 1956 the International Bureau, acting on the authority of the 10th (1954) General Conference, redefined the second in terms of the year A.D. 1800. As this year had already passed its period could be accurately determined by astronomical means and after four years' work this was completed to within four parts in one thousand million. In October, 1960, the 11th General Conference ratified this definition and urged that work proceed on finding a more accurate atomic standard.

The U.S. National Bureau of Standards had started work on an atomic standard in 1948. Their early efforts were based on atomic vibrations of the ammonia (NH₃) molecule but in the 1960s they found that even better results could be obtained by relating time to motions within the atom itself. This culminated in the development of the Caesium Beam Resonator which resonates at 9,192,631,770 MHz, to an accuracy better than one second in 6,000 years. In October, 1967, the 13th General Conference redefined the second in terms of this standard. Work is at present being carried out to construct even more accurate clocks, such as the hydrogen maser clock which promises an accuracy 100 times better than the Caesium Standard.

One of the major difficulties in the use of atomic standards for time measurement is that such clocks may be used only for defining and measuring **periods** of time, and cannot be adequately employed to determine a specific **instant** in time. An instant in time can only be determined by reference to some event which occurs, and for this purpose astronomical observations are required to determine instants of time.

In Australia such time instants, obtained from astronomical observations, are determined at the Mount Stromlo (A.C.T.) observatory by photographing certain stars at 24-hour intervals, scanning the photographic plates by photoelectric methods and processing the data with an I.B.M. 1620 computer. Atomic scale at Mount Stromlo is kept with a Hewlett-Packard 5060A caesium beam standard, and time pulses are exchanged by landline with the Deep Space Station DSN42 at Tidbinbilla (A.C.T.); P.M.G. standards in Melbourne; and the C.S.I.R.O. in Sydney. The phase of Australian standards is continuously compared with overseas sources to detect minor variations.

A difficulty arises in comparisons of astronomical

REFERENCE STANDARDS

periods and atomic periods in that they do not compare precisely, but vary both systematically and periodically. These variations occur because of time-dilation relativistic effects of the motion of the Earth, as predicted by the Special Theory of Relativity, and the gravitational doppler effect of the General Theory of Relativity, caused by the gravitational attractions between the Earth, Sun, Moon and Jupiter.

The kilogram was defined at the third General Conference in 1901 as:

"Le kilogramme est l'unité de masse; il est représenté par la masse du prototype international du kilogramme." i.e., it is represented by a platinum-iridium cylinder kept at the International Bureau at Sevres, near Paris. All signatory countries to the Treaty of the Metre possess copies of the international prototype which are accurate to one part in one hundred million. Presently there is no fundamental substitute for this prototype kilogram as atomic measurements cannot be made to the accuracy obtainable on a precision balance and the 1901 definition still holds, although recent advances in X-ray crystallography have suggested a method of determining mass by counting the number of atoms in a crystal. This method is not yet practical because of the difficulty involved in producing a perfect crystal of reasonable size.

Copies of the original length standard were initially made by laborious microscopic comparison with the lines inscribed on the original, but such a task has now been superseded by methods of interferometry. Interferometry involves counting "fringes of interference" of a light beam, and may be readily observed with two glass plates and a source of monochromatic light. If monochromatic light (i.e., light of a single colour) such as is available from a sodium discharge lamp is used to illuminate two glass plates placed in contact at one edge and separated by a piece of paper at the other edge, as in figure 1, interference fringes may be observed.

In this diagram light from the source is reflected from the top sheet of glass at B. More light passes through the top sheet of glass at C, is reflected from the bottom sheet of glass at D and joins the other (reflected) light at B. If the two light rays are in phase at B (i.e. if their peaks occur at the same time) the light observed will be more intense than the original rays as the effects are added, but if the rays are 180 degrees out of phase with each other at B, the effects cancel and no light is observed. The criterion for the two rays to be in phase at B is that the path-length A-D-B is an exact number of wavelengths different from the length AB, and for them to be 180 degrees out of phase the path length A-D-B must be an odd number of half wavelengths different from the length AB.

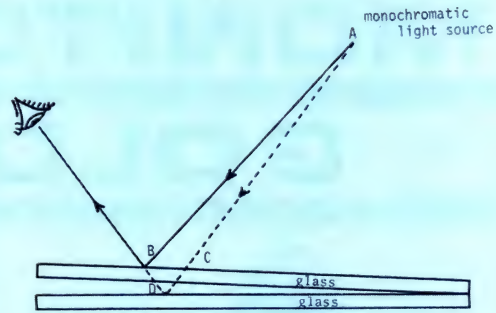


Figure 1. Reflection of light from different surfaces produces interference patterns.

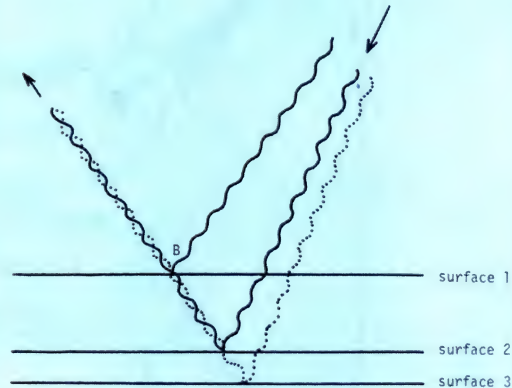


Figure 2. Phase relationships between light reflected from three surfaces.

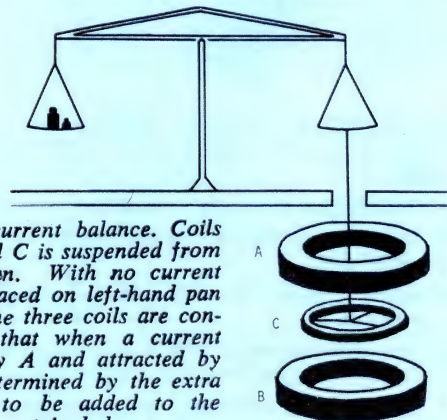
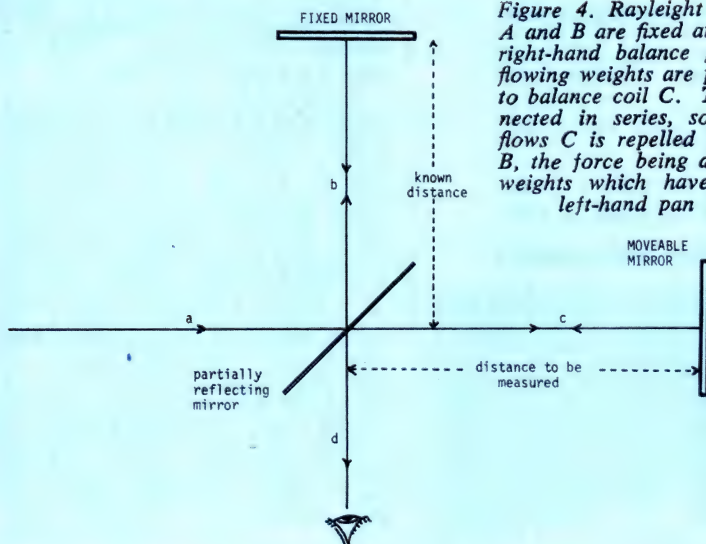


Figure 4. Rayleigh current balance. Coils A and B are fixed and C is suspended from right-hand balance pan. With no current flowing weights are placed on left-hand pan to balance coil C. The three coils are connected in series, so that when a current flows C is repelled by A and attracted by B, the force being determined by the extra weights which have to be added to the left-hand pan to retain balance.



LEFT: Figure 3. General principle of Michelson Interferometer. Parallel light beam (a) strikes partially reflecting mirror and part is transmitted to movable mirror (c). The two light beams return via (b) and (c) and are respectively transmitted and reflected by the partially reflecting mirror along (d) to the observer, who counts the fringes as the mirror moves along distance to be measured.

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This is illustrated in figure 2 where the light reflected from surface 2 is in phase (solid line) with the light reflected from surface 1 at B, but the light reflected from surface 3 (dotted line) is fully out of phase with the light reflected from surface 1 at B. The separation of the two glass plates (hence the thickness of the paper separating the plates) may be determined by viewing the reflected light along the length of the plates from the point where they touch to the point where they are separated by the paper, and the number of "fringes" (alternate dark and bright lines) seen represents the number of wavelengths separating the glass plates where the paper is inserted. If the wavelength of the light is known the thickness of the paper may be readily determined. As the wavelength of visible light is extremely small (for sodium light it is approximately 0.0006 millimetres) many fringes have to be counted to obtain even small measurements, but the accuracy of such measurements is correspondingly great. The Michelson Interferometer which utilises this principle is shown in figure 3.

By interference methods using common monochromatic light sources lengths up to about 20cm may be easily measured, and automated fringe-counting equipment has been developed to ease the task of counting. As normal monochromatic sources are not truly monochromatic, but are spread over a narrow range of wavelengths, distances greater than 20cm are hard to measure, as the interference patterns from the slightly different wavelengths tend to merge together after a few million fringes. Because laser beams are spread over an extremely narrow range of wavelengths such light may be used to determine much longer distances, and the U.S. National Bureau of Standards in 1963 succeeded in directly measuring a distance of 200 metres by counting fringes of the light obtained from a Helium-Neon Laser.

Due to reproducibility and accuracy of measurement of the wavelengths of light the 11th General Conference re-defined the metre as 1,650,763.73 times the wavelength of the orange light emitted by the krypton-86 atom. When measurements of this wavelength are made at the low temperature of -210°C (to avoid doppler broadening of the bandwidth) this standard is accurately reproducible to within one part in one hundred million.

An interesting point arises from the adoption of the metre as a fundamental length standard by the United States. Prior to 1893 the "yard" and "pound" used by the U.S. were based on the British Standards, but in that year they were redefined in terms of metric values. The U.S. "yard" was defined as 0.914,401,8 metre (exactly) and the U.S. "pound avoirdupois" was defined as 0.453,592,427,7KG (exactly). The British Imperial yard and pound avoirdupois are 0.914,398,4 metre and 0.453,592,338KG respectively. Although the difference between the U.S. "pound" and the British "pound" is extremely small, the differences in the two "yards" means that the U.S. Mile (1,760 yards) is 2.18cm (nearly one inch) longer than the British Statute Mile.

Although temperature is fundamentally a measure of energy its measure-

ment is important enough to warrant standardisation.

Temperature has always been difficult to measure for two reasons. The most obvious difficulty occurs in devising an accurate measuring device, and even the best modern methods of temperature measurement have accuracies not better than one part in ten thousand. The second difficulty occurs in obtaining accurately reproducible temperatures.

During the nineteenth century Lord Kelvin devised a scale of temperature in which the zero point is the point of zero thermal motion for an ideal gas. This occurs at 273.15°C below the freezing point of water. This temperature scale is known as the "Absolute Thermodynamic Scale of Temperature" or Absolute temperature and is expressed in Kelvins. (The word "degree" is now omitted from the absolute scale of temperature.) The Kelvin is equal in size to the degree in the Celsius scale, the difference being only in the zero reference point, for example $0\text{K} = -273.15^{\circ}\text{C}$, $273.15\text{K} = 0^{\circ}\text{C}$ and $373.15\text{K} = 100^{\circ}\text{C}$.

During the 1920s the International Bureau of Weights and Measures attempted to devise a practical scale of temperatures, based on the Celsius and Absolute temperature scales, by defining a number of fixed reference points such as the boiling and freezing points of very pure substances. These values were expressed as temperatures in the Celsius scale which were related to the Absolute scale by a constant difference factor.

The 10th General Conference re-defined the Absolute temperature scale with a single fixed point (known as the "triple point" of water) at 273.16K , which is only 0.01°C different from the freezing point of water. This fixed point can be reproduced with an accuracy of about one part per million, which is far more accurate than either the freezing or boiling points of water.

There are six defining points in the International Practical Temperature scale (agreed on in 1948), and these are all expressed in $^{\circ}\text{C}$. They are, (1) the boiling point of oxygen (-182.97), (2) the triple point of water (0.01), (3) the boiling point of water (100.0), (4) the boiling point of sulphur (444.6), (5) the freezing point of silver (960.8) and (6) the freezing point of gold ($1,063.0$). These measurements are to be carried out under certain specified conditions, as, for example, the boiling point of water varies with atmospheric pressure.

Measurements of temperatures outside this range — for extension of the temperature scale — is difficult, but temperatures down to 14K may be measured with reasonable accuracy by resistance thermometers and this extension may be the next adopted. For temperatures between about 1000°C and 4000°C optical pyrometers are used, and for temperatures above this spectroscopic methods are employed, but accuracies are limited.

In the realm of measurement, length, mass, time and temperature are considered as fundamental and other quantities are directly obtainable by the use of fundamental laws of Physics. Because of their importance, however, two other quantities have been defined. These are the Ampere for electric current and the Candela for light intensity.

The Ampere may be determined from the magnetic field produced by a current. This magnetic field exerts a force on a nearby magnetic field and the force may be determined by reference to length, mass and time standards. The definition of the Ampere recommended by the International Bureau in 1946 and adopted at the 9th General Conference in 1948 is the constant current which, when flowing through two parallel conductors one metre apart, exerts a force of two ten-millionths of a newton (the M.K.S. unit of force) for each metre of length of the conductors.

Although the Ampere is defined in terms of the force between parallel currents, in practice the conductors are wound in the form of coils of many thousands of turns and the force measured by comparison with weight-forces on a beam balance. An example of such a device is the Rayleigh Current Balance shown in figure 4.

The Candela, as it is a measurement of energy, may be directly expressed in terms of mass, length and time, but as readily accessible references are required it is more convenient to define it in a simpler form. The earliest "standard" form of a unit of light intensity is the Candle, defined in Britain as "the amount of light emitted by a sperm candle seven-eighths inch in diameter and burning 120 grains per hour."

As may be appreciated the Candle defined in terms of real candles is not very accurate, and in 1909 Britain, France and the U.S.A. agreed to a standard defined in terms of carbon-filament lamps. But even this was not good as the light intensity is dependent on age and other operating conditions. In 1948 the 9th General Conference adopted the Candela, defined as one-sixtieth of the intensity of light emitted from one square centimetre of a fully radiating body at the temperature of freezing platinum (1769°C). This value

is very close to the "Candle" of the old British system.

In practice the radiation from a perfect radiator is not easy to use, so it is initially used to calibrate filament lamp substitute-standards which are used for more routine calibrations.

If only standards of length, mass, time and temperature were obtainable at Standards Bureaus throughout the world the calibration of industrial and scientific instruments would be an extremely laborious task. For this reason many second-order standards such as standards of resistance, inductance and capacitance are kept so that equipment may be directly calibrated, or substitute standards compared for accuracy.

The second order standards are derived directly from the fundamental standards. For example the Volt is defined as the potential difference across a conductor which dissipates a power of one watt when the current flowing is one ampere. The resistance of this conductor is one ohm, thus the ohm is automatically defined. As the watt is directly related to the kilogram, metre, second and kelvin via its heating effect the second order standards may be determined.

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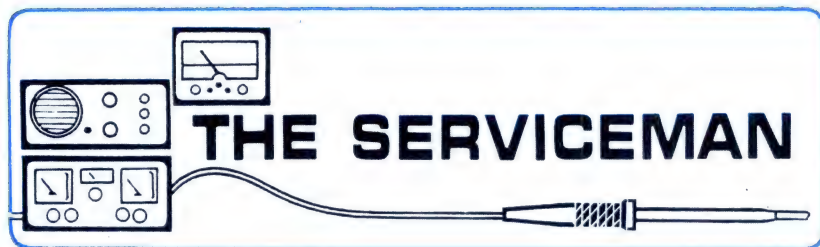
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THE SERVICEMAN

"Sneaking up" on Intermittents

The law of "The Perversity of Inanimate Objects"—somewhat similar to Murphy's Law—may well be dismissed by the academics as mere superstition, but I'll bet none of them have ever tried to catch up with an intermittent fault in a piece of electronic equipment.

In the March issue the Editor suggested that fellow servicemen may like to contribute unusual service stories for inclusion in these columns. The first of these comes from J.C. of Merrylands, N.S.W. who seems to have evolved a method of "sneaking up" on intermittents under the pretence of fixing a completely different fault.

Here is the story as he tells it.

"The service call I am about to describe was really a continuation of one I had made to the same set several weeks previously, even though it didn't start out this way. On the previous service call the customer had complained about the sound section.

"'Sometimes,' she said, 'I can't turn the volume down. It's much too loud and I'm afraid the neighbours will complain.'

"As you may have guessed, the whole crux of the matter was the customer's word 'sometimes.' It indicated an intermittent and, although I went through the motions of making a call, I wasn't really surprised when I could not fault the set in any way; nor was the customer, apparently. While assuring me that the sound was much too loud at times she also said that she felt quite sure that it would behave itself the moment I put my foot in the door.

"There must be a 'presence' about TV servicemen; something like the inexplicable 'difference' which allows a criminal to sense a plain clothes policeman no matter how carefully he tries to hide his identity. Only in this case it is the TV set which senses the serviceman. Thus no piece of equipment suffering from an intermittent will misbehave from the moment one puts one's foot inside the door until one has driven away around the corner.

"There was little I could do in these circumstances, except try to find out all I could about the fault in preparation for the next time.

"'Maybe the station was only winding up the sound on the advertisements,' I suggested.

"'I can't imagine they would turn it up that loud,' she replied. 'Besides, it doesn't only happen on the advertisements. Sometimes it goes for hours at a time.'

"Which seemed to settle that argu-

ment. All I could do was to advise her to contact me when it gave trouble again. Which was the last I heard of the problem until yesterday, so I had assumed that it had given no further trouble. And even yesterday's call seemed to involve something quite different, since the scribbled phone message said. 'No picture. Weak sound.'

"When I arrived at the customer's home there was no mention of the pre-



I don't know why I bother switching it on!



Please be quick—I'll be lost without it!—("TV Times.")

vious fault, so I went straight to the business of checking the 'no picture' fault. I turned the set on and waited for it to warm up. When it did it confirmed the customer's complaint; there was no picture, and there was only weak sound, although I noted that the sound still responded to the volume

control. I also noted that there was still a raster on the screen, an important clue in any 'no picture' diagnosis.

"Loss of picture, while the raster remains, indicates that the horizontal deflection system and EHT supply — which represent a substantial proportion of the circuitry — is functioning normally, and that the fault will be somewhere in the signal path. If the sound is normal then the trouble will almost certainly be somewhere in the video section, not excluding the picture tube itself.

"If, on the other hand, the sound has failed completely, as well as the picture, the failure is most likely to be ahead of the video detector. This reasoning still leaves a substantial portion of the set to be investigated, but at least one does not waste time looking in the wrong places.

"In the present case the symptoms were not quite so clear cut, in that the sound was neither normal nor absent, but simply weak. I wonder if any readers can pick the likely section which would cause this fault?

"Fortunately I didn't have to have to indulge in any very deep reasoning to work it out: I had been through that exercise a long time ago with this particular make and model of set. I went straight to the last IF transformer, removed the can and snipped out the video detector diode. A quick check on the low ohms range of the voltmeter confirmed my suspicions; the diode read 'short circuit' in both directions.

"Previous experience has also shown that the most likely cause of this fault is a flashover inside the 6DX8 video amplifier, so I always make it a practice to replace this valve also. Failure to do this is inviting trouble in the form of call-back and loss of reputation.

"With everything back in place it was time to switch on. Can you imagine being crouched down behind a TV set, about 18in from the loudspeaker, with the sound turned full on? Well I was, I couldn't get to the volume control quickly enough. The only snag was it was already turned right down. So this was the fault I had been called to a month previously.

"The worst aspect of finding the fault was the fact that I had to leave the set playing with the sound flat out while I looked for it. At my suggestion the customer retired to another part of the house and closed the intervening doors. I simply did my best to ignore it.

"I first checked the leads and connections to the volume control, but these seemed too intact. Then I started probing around the wiring board carrying the sound section. It soon became evident that there was an intermittent somewhere on the board because, by springing it gently, I could cause the fault to come and go.

"The wiring boards in this set are made from brown insulating board on which is a pattern of terminals in the form of eyelets or hollow rivets. The components are mounted on the board and wired to the terminals. The board sits over a cut-out in the chassis and around the edge of this cut-out are metal tabs which are punched as part of the cut-out then bent upwards. These correspond with various earthy terminals on the board, and are soldered directly to them.

"Various earthy leads belonging to

components remote from the board, but associated with it electrically, are also connected to earth terminals on the board, these being specially provided for this purpose.

"This fault involved the earthy lead from the volume control. The lead was soldered to the terminal on the board all right, but close examination showed that the terminal had broken away from the chassis tab. Naturally, it didn't take much effort to rectify this situation, after which the sound was once more controllable.

"The customer admitted when we discussed the fault afterwards that the problem had occurred a few times in recent weeks, but she had not bothered to call me.

"From the trend of her remarks, I got the impression that she was afraid I would not believe her story of what was going on unless I was on the spot when the set played up. This impression was strengthened when she added that she was glad I had been able to hear it for myself.

"I was glad too, but I think I will add a roll of cotton wool — ears, for the use of — to my tool kit."

On quite another theme, I received a letter from Mr J. S., of Auckland, N.Z. His letter was prompted by the story in the issue of October last, in which a fellow serviceman related how he had been caught by a pair of new, but faulty, 6CM5s. Here is his letter.

Dear Sir,

"The Serviceman" in your October 1969 issue mentions a case of a TV serviceman being confronted with a "no picture" condition which led him to suspect a defective line output transformer. After substituting valves in the affected section and making various other unspecified checks, the repairman came to the conclusion that the L.O.P.T. must have been the cause of the trouble. In order to prove his suspicion he had to remove the old transformer and wire in a new one. Unfortunately, the new transformer did not improve matters and it was necessary to refit the old one.

As a practising serviceman I must confess to a feeling of incredulity after reading this. Even a non-serviceman reader must have wondered whether there could not have been some way of testing the suspected transformer "in situ," rather than being forced to adopt such a clumsy and time-consuming approach as replacing it. The account of this retold tale, originating with an employee of "one of the larger service organisations," leads me to wonder if all Australian servicemen are unaware of the existence of a piece of test equipment known as a flyback checker. This handy little gadget, which is about the size of a multimeter, can easily be carried in a serviceman's kit and has been in use in this country for the past six years.

Can it be that we in New Zealand are in possession of something unknown to our Australian counterparts?

Faults in line output transformers can be summarised as follows:

1. Open circuit in winding.
2. Arcing, either between windings or from winding to core.
3. Shorted turns.

Open circuits can be checked with an ohmmeter. Arcing can be spotted visually, as well as aurally and nasally

too, sometimes! This leaves No. 3 which, without the use of a flyback checker, leaves no recourse but to substitute a new transformer. This statement applies only to "in the field" conditions for it is possible to use an oscilloscope to conduct what is known as a "ringing" test on the workshop bench.

As the person responsible for having this checker marketed in N.Z. I am in a position to know that it has been well received by the trade. Furthermore, the largest service organisation in the country has, more recently, marketed its own version. It has become a "must" in every serviceman's kit.

Yours faithfully,

J.S. (Auckland, N.Z.).

My first reaction, on reading this letter, was that my correspondent had missed the point of my story, which was more concerned with the coincidence of two faulty, but new, valves being selected in succession for a replacement test, than it was with methods of diagnosing faulty output transformers. However, I must agree that the situation was aggravated by the fact that the serviceman did not have a means to double check his diagnosis. On this basis, J. S. has a point; the frustrating situation which followed would have been avoided had the serviceman been able to double check his findings with something along the lines of a flyback tester.

Fair enough. But let us look at it another way. As far as the serviceman was concerned, the failure of the transformer was virtually established before he removed it. He replaced it, not "on spec," but simply as a logical result of having concluded that it was faulty. What's more, his conclusion was perfectly valid on the basis of the observed symptoms; in other words, if the replacement valves had been good ones, and he had still observed all the other symptoms which he did observe, then he most certainly would have had a faulty transformer. In short, his test equipment — the replacement valves — let him down; not the first time a serviceman has been led up the garden path by a piece of faulty equipment.

Which brings us quite naturally to the question; would he have found the real fault any sooner had he used the tester under discussion? He probably would have — IF everything had gone according to plan. For example, IF he had felt sufficient doubt about his diagnosis to bother making such a check. Or IF he had bothered to carry this particular piece of gear with him on that particular job.

The truth of the matter is that it simply is not a practical proposition for a serviceman to carry every piece of gear which — in theory at any rate — would prevent him from making such mistakes. Nor is it valid to argue that only one piece of gear would have been needed in this case. Such an argument is valid only with the wisdom of hind sight; a point which is very often overlooked in post mortem's of this kind.

Perhaps the fact that stories such as these are published is, in itself, misleading. What must be remembered is that they are published because they are the exceptional stories, the very opposite of the routine day-to-day jobs

from which a serviceman makes his money. Sure, the fellow concerned was hopping mad about it at the time; but would he run out and buy this piece of test gear against the possibility of a similar situation occurring again? I thought it only fair to put this question to him.

It turned out that he was familiar with this device — or at least the existence of it — and even suggested the name of an Australian firm which was marketing one. He went on:

"I have often made the point that I would like to carry some extra pieces of equipment. However, company

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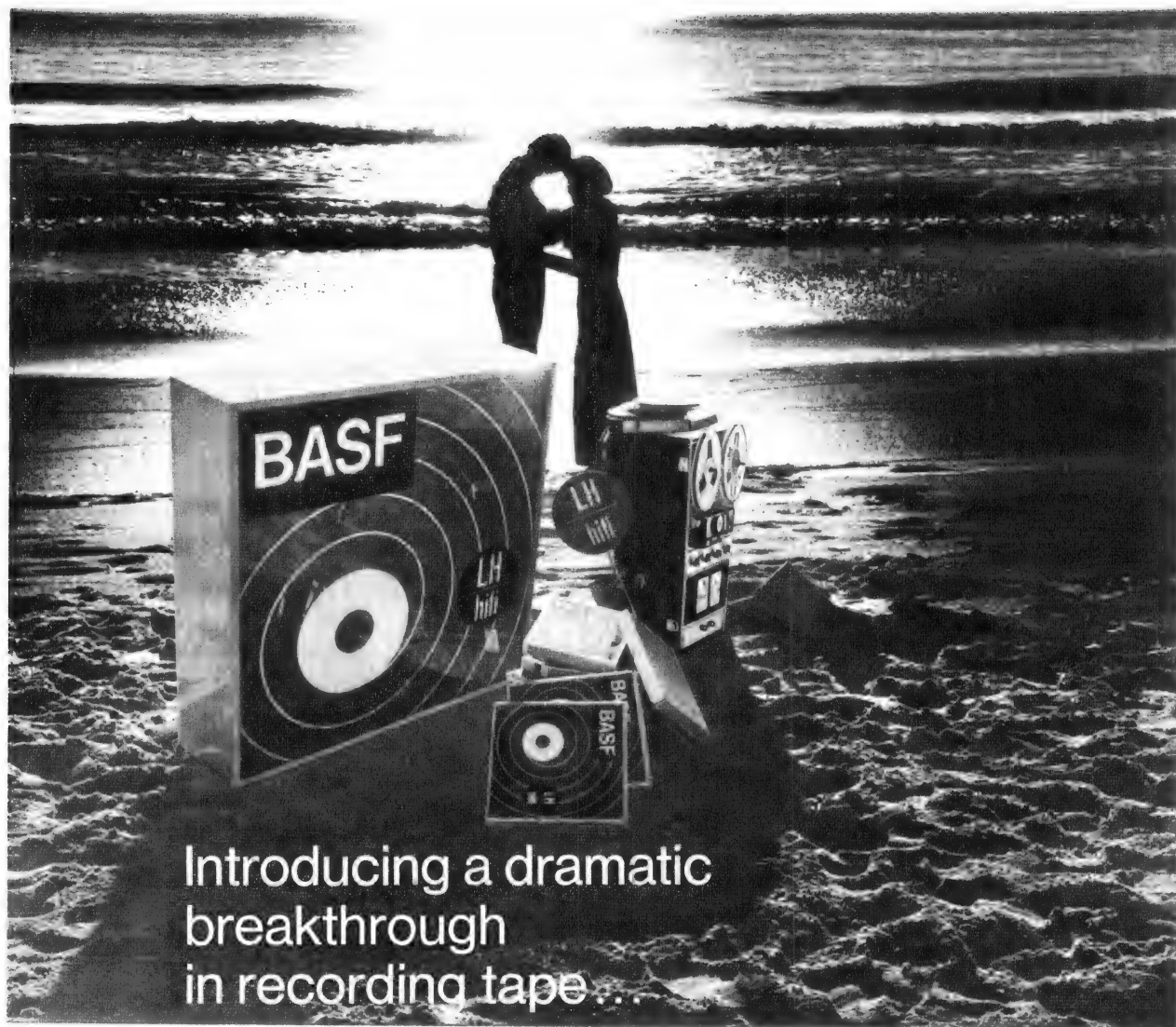
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policy is that field servicemen need carry only a minimum of equipment suitable for the simpler faults. Faults which cannot be serviced with this equipment should be brought back to the shop where full facilities are available.

"And in fairness," he went on, "I must point out that the case in question was the first time in over seven years of TV servicing that I have been caught like that. I reckon I could claim that I can pick a faulty output transformer 999 times out of a thousand — even allowing for a pair of dud new valves.

"Is it worth carrying, say, \$30 worth of gear to check one in a thousand?"

"I can assure you the company wouldn't think so. With a large number of servicemen on the road they would logically have to equip each one with such a device. They just couldn't justify the outlay if each unit was used only once every few years. It would probably be worn out from being carried around in the truck before it could be used more than a few times."

I put it to him another way: "If your company gave you the O.K. to spend a significant amount of money on extra equipment, would this device be among the first you would buy?"

"No, by gee it wouldn't," he replied. "I'm not sure what I would buy first, but it wouldn't be that.

"Mind you," he added, "Even my multimeter does not get that much use. I suppose I would take it into a customer's home about once in every two days. For the rest I rely on what I can see on the screen and on experience."

To get another slant on the situation I tried another colleague; one who is in business for himself, is essentially a one man show, has been going since the start of TV, and who seems to prosper without making exorbitant charge or resorting to snide tactics.

"At one time," he said, "I might have welcomed such a device but, with experience, one soon acquires what is almost a sixth sense about these things. So much so, that I don't regard it as a problem these days. In the main, there is only one brand of EHT transformer which gives any real trouble. When I encounter a set with an EHT failure, and using one of these transformers, I would suspect it immediately I had disposed of the more obvious checks, such as replacing the appropriate valves and confirming that there is drive from the line oscillator stage.

"On the other hand, there is a brand of EHT transformer which I honestly cannot remember ever having had to replace. In a similar situation involving a set with this transformer in it, I would not suspect the transformer until all other possibilities had been examined.

"In addition, most transformers give some clue when they fail. For example, the unreliable transformer previously mentioned usually overheats badly. About one minute's operation makes it too hot to touch.

"As far as I'm concerned I would not consider buying any apparatus for checking EHT transformers. In fact, the only instrument I carry on field servicing is a VTVM. That, plus essential tools and replacement components, is all that I find I need."

As far as I can determine, the foregoing appears to be a fair summary of the attitude of most servicemen. Whether working as a one man organisation or as part of a large service company they make their money from the routine type of fault which can be rectified in the customer's home and which represents about 95 per cent of their work. The remainder are the difficult ones which are normally returned to the workshop for more intensive examination.

In the field the serviceman works with a minimum of equipment and a maximum of experience. And make no mistake about, experience counts most in this situation. To quote my second colleague again. "The less you know, the more equipment you need."

On the bench, where the hard ones accumulate, it is a different matter. Experience counts here too, but needs to be backed by good technical training and, with in reason, adequate equipment.

This system — fixing the easy ones in the field with a minimum of equipment and the hard ones in the workshop — works very well in practice. The majority of sets are repaired with minimum cost to the customer and without the set leaving the customer's home. (Customers don't like their sets being taken away). What's more, it achieves this with a minimum of capital outlay on equipment and with a minimum of this equipment out in the field where, inevitably, deterioration will be high due to handling, transport, etc.

As I say, the system works well. The only minor snag is that, once in a while, one gets caught. What looks like a simple fault, capable of being fixed on the spot, turns out to be a difficult one that should have been returned to the shop. Unfortunately, by the time one realises this, one is so committed in terms of time already spent that there is a strong temptation to press on and try to justify it by at least getting the set going on the spot.

Which is exactly what happened to my colleague with the two supposedly good 6CM5s. It was no reflection on either the serviceman, the firm for which he worked, or the broad concept of service as it is generally practised.

It was just one of those things.

Following my remarks in the December issue about the compatibility of TV sets from one country to another country, I received the letter reproduced herewith. It appears to be from a European migrant and, while I am not sure, I gather he is taking me to task a little because I sounded a note of caution in this regard. Apparently, he feels that the fact that he bought a set into the country and is receiving all the local channels on it, is convincing proof that there is no problem.

Dear Sir,

In the December issue, "The Serviceman" discussed the compatibility of foreign TV sets. Having just visited Europe, I bought a small all transistor TV set while there. It was built in Japan for German standards, which include both UHF and VHF channels.

This set has a 12-channel switch for VHF and a separate switch giving about 50 channel variations on UHF. Since Australia has no UHF transmis-

sions an Australian set will have only limited usefulness in Europe.

On my arrival in Australia I found that all four channels in Melbourne were received perfectly — both sound and picture. Incidentally, The Serviceman was right about the Customs duty, I had to pay \$94 to bring it in. Price in Germany — \$75.

Yours faithfully,
R.F. (St. Kilda, Vic.).

All I can say is, "You were lucky, mate." But I wonder if you realise that there are several channels in Australia which your set cannot receive. In Melbourne, or most of the other capital cities, you can cope. Your set will be "near enough" for channels 0 and 2, "spot on" for channels 6, 7, 8 and 9, and "near enough" for 10 and 11. But what of channels 3, 4, 5, and 5A? There is a complete gap in the European channel system over this range. If you happen to move out into the country area, many of which are served by two of these channels and nothing else, your set would be virtually useless.

So, to anyone aspiring to bring back sets from overseas, I would repeat my warning. Be very careful and very sure that you have checked all the possibilities. Otherwise you could pay out a lot of money for something of limited usefulness. Oh, and don't forget some spare parts while your about it. You might find it hard to get your European set serviced otherwise, should something vital fail.

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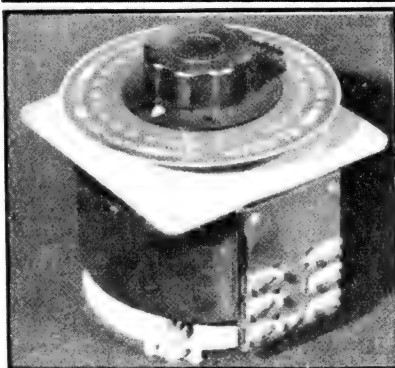
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Disappearance from the local market of certain types of ceramic filter has threatened the viability of two of our popular designs, the Playmaster 122 and 123 program sources. Fortunately, suitable substitutes are available.

When we originally developed and described the two program sources (or radio tuners) we had a choice of two brands for the simpler filters: "National" imported by STC and "Murata" imported by IRH.

After some consideration, we settled for two of type D455K1 and one of type D455K3; both imported by STC. These were of different bandwidths and with a tolerance on centre frequency of $\pm 1\text{KHz}$. Subsequently we were notified that only wider tolerance units would be available in future; the type numbers of these would be D455K2 and D455K4 respectively, and the tolerance $\pm 2\text{KHz}$. However, the importers agreed to make available matched sets of three filters for use in these tuners; this arrangement prove to be satisfactory, although somewhat confusing for readers at the time.

Then, a few months back, we learned that no more D455K2 and D455K4 filters would be imported. Fortunately, good stocks were already available on dealer's shelves and there was no immediate need to consider possible alternatives.

In recent weeks, however, there has been an accelerated demand for the particular filters and, just before going to press, stocks were virtually exhausted.

Fortunately, the alternative Murata range of filters is still in good supply, including types which will replace those originally specified. There are electrical and mechanical differences but substitution is nevertheless possible.

The D455K3 used between the AGC amplifier and the AGC rectifiers may be replaced with its electrically similar Murata counterpart, type SFB-455A. The physical configuration is slightly different and the necessary mounting modifications will be dealt with later.

The two coupled D455K1 filters posed a problem at first but we found that they could be replaced by a single Murata SFD-455B filter with little change in the overall response curve. This latter filter is, in fact, made up of two SFB-455A filters mounted within the same case. It is assumed that external capacitive coupling will be provided between the two sections, affording a degree of control over the bandwidth.

The value of the coupling capacitor may be adjusted experimentally but we found that a value between 68pF and 82pF gave a bandpass characteristic very close to the original.

(The fact that the SFD-455B filter is two SFB-455A filters in the one case is itself interesting. In the event of the latter filters not being available at any time, one half of an SFD-455B filter can be used instead, the unwanted leads being clipped off or bent up out of the way.)

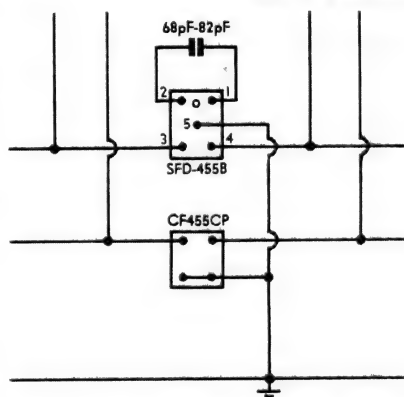
As there are still many printed boards on dealers' shelves, we set out to see what could be done to fit the Murata filters in the spaces provided for the original filters. Happily enough, the problems are easily overcome and this is how we went about it.

The easiest one to deal with is the

the case. Then bend the pin at a right angle again so that it will enter the hole. The pins are then soldered to the copper on the board in the usual way. Some of the copper will be lost in filing and care should be taken to make sure that a good joint is made between the available copper and the pins.

An alternative but less neat approach involves turning the filter upside down against the board in the appropriate position. Thin tinned copper leads are soldered in the holes on the board and brought up to the respective pins which are bent over to meet the leads and soldered.

A close-up of the modified board showing the SFD-455B filter upside down at lower left and the SFB-455A, angled at 45 degrees, upper right.



This diagram, which can be related to the original circuit, shows the revised connections to the SFD-455B filter. The Murata CF-455P wideband filter is still readily available.

single filter in the AGC circuit. Physically, the National and Murata filters for this position are different. However, they each have three pins, i.e., input and output, the third and offset centre pin being connected to earth in each case. The input and output pins on the Murata filter are a little closer together than the National, while the Murata centre pin is not offset as much as the National.

The neatest way to mount the new filter is to use a jeweller's file and file the holes in the board, corresponding to the input and output pins, such that the pins may be pushed through the holes. This leaves the offset of the centre pin to be adjusted. Bend the pin first outward and at a right angle to

In the other case, where the original pair of filters is to be replaced with a Murata SFD-455B, it is not possible to alter the board to solder the filter directly to the copper points. Here, the problem is best met simply by doing just what we have described as the alternative for the single filter. The new filter is mounted upside down on the board where the original filters were located. Tinned copper connecting leads are used as described earlier to connect the input, output and earth pins. The top coupling capacitor, with short leads, is soldered across the remaining two pins, nearest the dot on the case.

The foregoing description will be clearer when the close-up picture of the relevant part of the board is inspected.

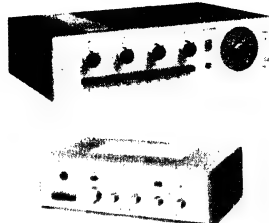
Although we have shown how to mount the new filters on the boards currently available, we propose to modify the boards for future use and, in due course, some manufacturers may see fit to produce a modified board. Meanwhile, there is no reason why the above method should not be adopted.

We have drawn the slightly modified circuit for the coupled pair and this simply shows the two elements in one enclosure, with the addition of the top coupling capacitor. We have shown the value as being either 68pF or 82pF. The larger value of capacitance simply broadens the selectivity a little and is the one we prefer as the selectivity approximates the degree of selectivity which we obtained in the original circuit. The type of capacitor which we prefer is the readily available Styro-seal, which is stable, small and light in weight.

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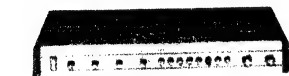
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UNIT 6—

2 Leak Sandwich Mk II loudspeakers, cross over frequency: 900 Hz via sophisticated 6 element filter. Impedance: 15 ohms nominally, PE 34 belt-driven turntable with Empire 808 cartridge, frequency response 10-20,000 Hz with 30 dB of stereo separation, compliance: 8 x 10⁻⁶ cm/dyne. Total Price: \$380.00. With a Monarch Model SA 500 amplifier, \$380.00.

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A READER BUILT IT

Triac Test Added To Tester

The Transistor Test Set described in the August 1968 issue had no provision for testing Triacs, this being regarded as a somewhat specialised requirement at the time. However, a reader who needed this facility described how he added it to the original instrument.

We needed a simple way of checking Triacs, which we use in temperature controllers, speed controllers etc. Since we also had some need for a transistor checker, we decided to modify the design described in August, 1968, "Electronics Australia."

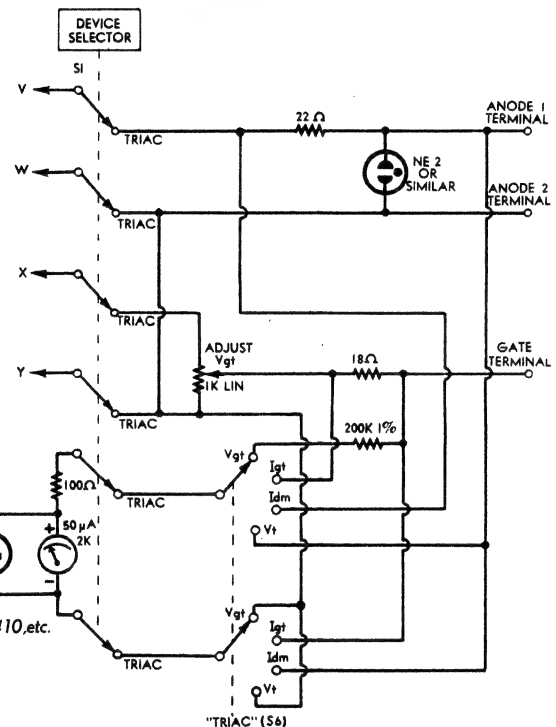
To obtain an extra position for "Triac" on the Device Selector switch, the two transistor positions (NPN, PNP) were combined and selected on a second 2 position, 6 pole switch. This is a fairly straightforward operation.

The other positions of the Device Selector switch were moved around one place and the last position was used to select the Triac tests. The circuit enclosed was used to wire up the Triac tests, the remainder of the wiring remaining as shown in the original article. A list of the tests, conditions and conclusions is appended.

Testing of silicon controlled rectifiers is also possible, provided they have a breakdown voltage greater than 200 volts. The significance of the measured parameters changes however.

Mechanical modifications we made included the use of a larger meter which we had on hand, fitted into a larger sloping front case. However, there should be enough room in the

The circuit shows the additions necessary to the original circuit to enable it to test Triacs. Only one position of S1 is shown, the other positions will be found in the original circuit. S6 is a new 2-pole, 4 position switch to control the testing functions when S1 is on "Triac." This circuit should be studied in conjunction with the one for the original test set. (Page 37, August, 1968, issue.)



CIRCUIT FOR "TRIAC" SECTION OF TRANSISTOR TEST SET

DEVICE	TEST, CONDITIONS	COMMENTS
TRIACS May be used for SCR s. See text	Vgt (Vdx = 200V) D.C. Gate Trigger Voltage 10 Volt Range	Measured by adjusting Vgt from zero until indicator neon goes out. Normally Vgt well below 10V. FAILURE OF NEON TO EXTINGUISH INDICATES OPEN CIRCUIT OR TRIAC WITH INBUILT "DIAC."
	Igt (at Vgt found above neon off) D.C. Gate Trigger Current 20mA Range	Normally less than 20mA. Zero indicates Gate OPEN CIRCUIT. F.S.D. indicates gate SHORT CIRCUIT.
	Idm (Vdx = 200V) (neon on, Vgt = 0) Off state voltage 5mA range	Normally less than 1 mA. F.S.D. = A1/A2 SHORT.
	Vt (neon off) On state voltage 10 Volt Range	Normally 0.5 — 2 Volts. F.S.D. = A1/A2 OPEN CIRCUIT. Zero = A1/A2 SHORT CIRCUIT.

This table, showing the various tests and results for Triacs, is designed to coincide with the table in the original article. It may be added below it or in any other convenient place.

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Photograph by courtesy of the ANZ Bank, Melbourne

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A READER BUILT IT . . . continued

Enlarging Exposure Meter

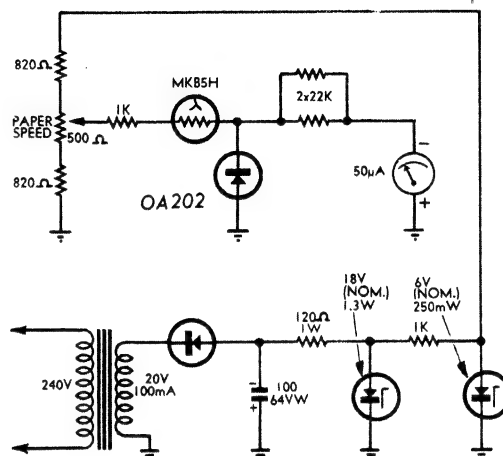
Amateur photographers may be interested in this latest suggestion for an enlarging exposure meter. The author claims that many of the objections to previous designs can be overcome by using the more sensitive cadmium selenide light dependent resistor.

The use of a CdSe LDR in lieu of a CdS appears to overcome most of the previous objections to this type of a darkroom aid. (R TV and H., March, 1963, page 76). The LDR is certainly small enough and sensitive enough to handle all the negatives I have, measuring the darkest "important" part. The sensitivity is also adequate in the blue region for evaluation of colour negatives through narrow cut tri-colour filters. Unfortunately, the variation between individual LDRs of this type (MKBSH, available from Proops Bros. London) is enormous; the second LDR I obtained recently appears to be only suitable for measuring the brightest part of the negative. This method seems to be gaining popularity and may be as good as the other. The response time of both units is quite satisfactory and very much superior to the "fast response" CdS cells such as ORP 63.

(Submitted by: T. J. Matulevicius, 109 Warrigal Road, Surrey Hills, Victoria, 3127.)

(Editorial comment: We have published the above circuit and comment as

The main feature of this circuit is the use of relatively high sensitivity cadmium selenide (CdSe) photocell in place of the more conventional cadmium sulphide unit. The cadmium selenide cell also has improved sensitivity at the blue end of the spectrum. Availability of these cells may be a problem.



an item of general interest to those readers who have been seeking a satisfactory solution to the problem of determining enlarging exposure. However, while the CdSe cell appears to have some advantages over the CdS cell, it

leaves some objections unsolved and creates at least one new one of its own. Increased sensitivity and rapid response time are in its favour, as is spectral response, which appears to be in the blue region. Against this is an apparently

very wide spread of characteristics and, for Australian readers, the fact that there appears to be no supply in this country. Presumably they would have to be obtained from the English firm mentioned by the contributor.)

Car Burglar Alarm

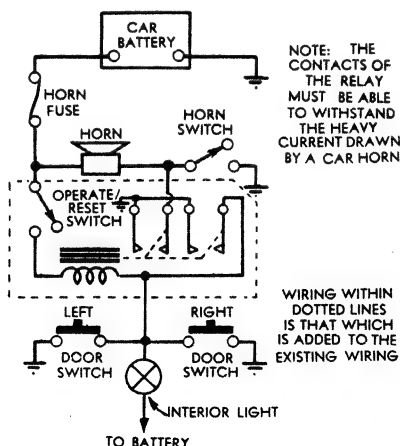
Here is a simple and inexpensive burglar alarm which may be fitted to any vehicle which has an interior light operated by either of the front doors.

After being set, this alarm will operate the horn of the vehicle until turned off by the reset switch, which is mounted in some accessible, but inconspicuous position on the exterior of the car. Positions for this will suggest themselves to readers studying the construction of their own car. When either of the front doors is opened, a relay pulls in a set of heavy duty contacts which operate the horn. This relay should be of a type to match the voltage of the particular vehicle. The horn contacts must be heavy-duty types, as some horns draw large currents — 10 amps or more in some cases. A second set of relay contacts are required to provide a latching circuit whereby the horn is kept in operation once started. The current carried by these latter is quite modest.

The unit should be wired with fairly thick wire, again for the reason of high current. If the wiring is exposed (e.g.

that to the exterior switch) it should be adequately waterproofed. The same applies to the switch itself.

The original unit was installed in a



NOTE: THE CONTACTS OF THE RELAY MUST BE ABLE TO WITHSTAND THE HEAVY CURRENT DRAWN BY A CAR HORN.

WIRING WITHIN DOTTED LINES IS THAT WHICH IS ADDED TO THE EXISTING WIRING

Components inside the dotted line are those added to provide the alarm. No polarities are shown and the system is suitable for either convention.

(Editor's Footnote: "Reader Built It" projects are published for the general interest of experiments and as a source of ideas. Based on readers' contributions, they have not been tested in our laboratory and we cannot accept responsibility for them.)

Volkswagen, and has performed with very satisfactory results.

(Submitted by: P. J. Evans, 118 Laura Street, Ekibin, Qld. 4121.)

(Editorial comment: While we have described a number of burglar alarms, some suitable for cars, this design may appeal to readers by reason of its simplicity and economy. One point, however, should be noted; the horn operates until turned off at the reset switch. In the event of the owner being absent for any length of time, and the alarm being tripped, he would return to find a flat battery. Although a car with a flat battery is preferable to a stolen one, readers may care to incorporate some type of time delay switch to turn off the device after a set period.)

Amplifier — Cont.

(Submitted by: Mr P. L. Rossiter, Physics Department, Monash University, Clayton, Victoria, 3168.)

Editor's note: It would appear that there may be a risk of damage to the driver transistors in the event that either one is "cut off," since both transistors have absolute maximum collector-emitter ratings of 50 volts. In view of this, constructors may wish to substitute higher rated driver transistors or reduce the supply voltage below 50 volts. 2N5322 or 2N3645 can be substituted for BC177 and 40408, 2N2102 or 2N3568 can be substituted for BC107.)

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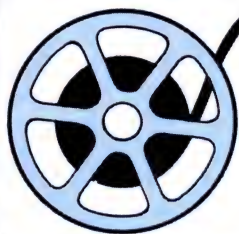
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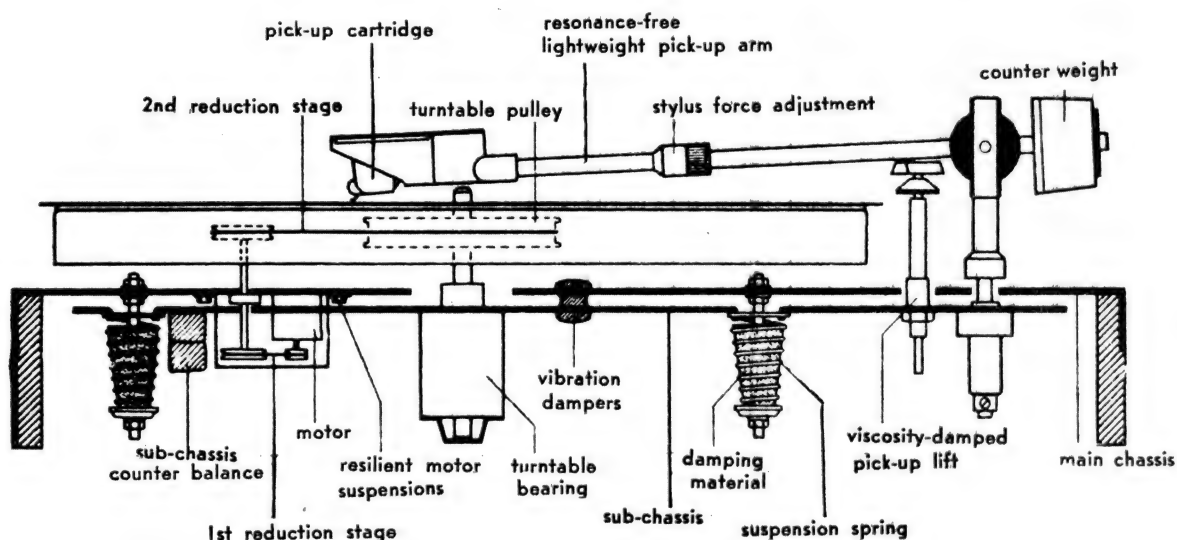


AUDIO TOPICS



Electronically controlled turntable deck based on new principles

Recently announced in Europe by the Philips organisation is a new type of gramophone turntable deck with speed control device which departs radically from conventional techniques. Called the GA202 "Electronic," the turntable uses an all-electronic system to control the speed of rotation and to switch off the unit.



One of the most significant developments in the design of this deck is the use of a DC motor, the speed of which is constantly monitored and controlled by fully stabilised transistor circuitry. Drift, wow and flutter are suppressed in microseconds, claim Philips, and the motor is isolated from mains voltage fluctuations and independent of mains frequency.

It is claimed that, because the need for the flywheel effect of a heavy turntable is eliminated, the whole moving system can be made much lighter. This reduces the load on the motor and main bearing so that this system can be mounted on a free-floating sub-chassis while the controls are placed on a rigidly mounted plinth unit. Such an arrangement gives substantially increased immunity to external shock and vibration.

Switching on and off is done silently by means of a bi-stable multivibrator. Automatic switch-off at the end of a record is achieved by means of a photo-electronic circuit operated by a

vane attached to the pick-up arm. The advantages of this system are two-fold. There are no additional mechanical forces operating on the pick-up arm, thus there is no undue wear on the record or stylus. Also the pick-up can be placed in any groove of the record, no matter how close to the run-out groove, without premature tripping.

As the motor speed is electronically controlled, speed selection is carried out by switching electronic circuits and each individual speed has its own fine adjustment control.

The pick-up arm has been designed as a result of mathematical analysis so that the actual tracking error is within a small design value, independent of the unavoidable tolerances on off-set angle and overhang.

To complete the picture a new cartridge, called the Super M, designed for use with the turntable, employs the latest advances in the field of micro-engineering including a magnet hardly larger than a grain of wheat and ten times lighter than a postage stamp but

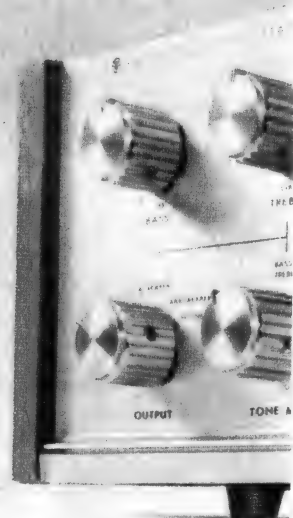
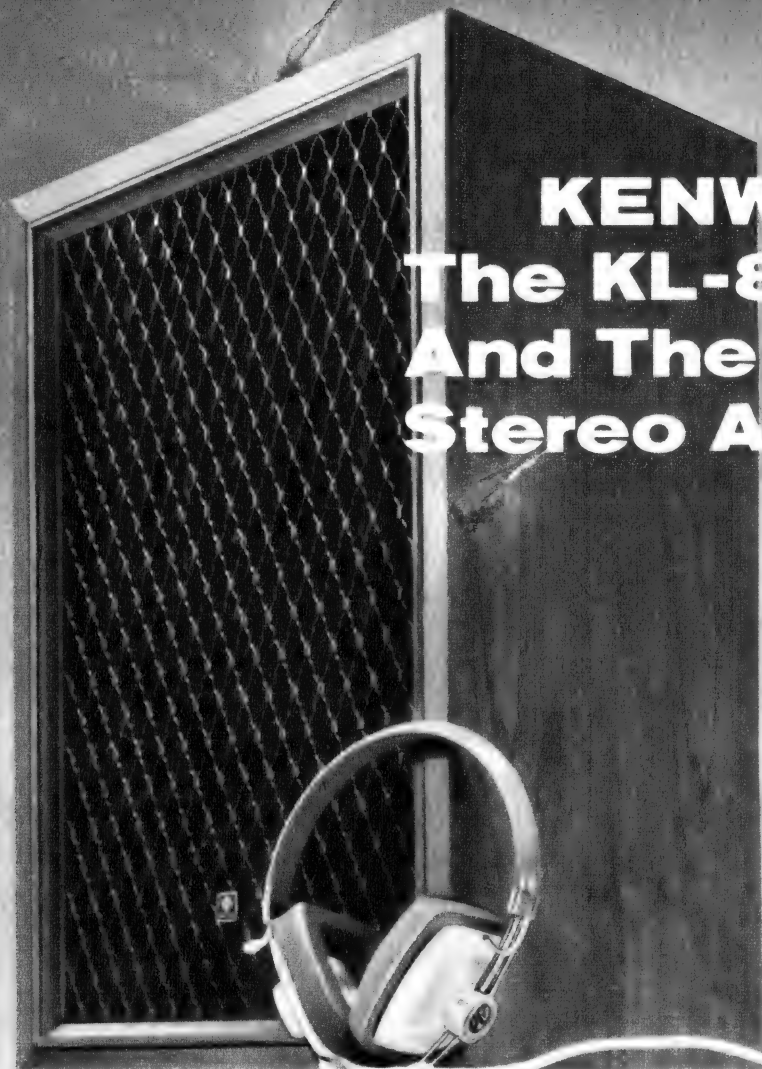
having a nominal flux density of 8,500 gauss.

The main features of the design are illustrated in the diagram.

To isolate them from shocks and external vibrations, the turntable and the pick-up arm have been mounted on a sub-chassis which is suspended from the rigidly mounted main chassis.

This construction permits considerably more flexible springs to be used than when the entire chassis is spring-mounted. In the latter case, the flexibility of the springs is restricted, because the operation of the controls must not cause appreciable movement of the record deck. The advantages of the new system are threefold: better isolation of the critical parts against shock and vibrations, more accurate cueing as the movement of the arm-lift lever does not cause any displacement of the sub-chassis, and better damping of the effects of heavy shocks. As the motor is independently suspended underneath the main chassis, the pick-up arm is doubly isolated against vibrations. ("Electronics Weekly").

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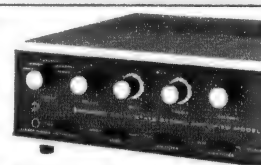
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LOUDSPEAKER POWER RATINGS

This brief article discusses a problem which very commonly faces hi-fi enthusiasts: Can they use modestly powered loudspeakers with much higher-powered amplifiers? What can be done to protect the loudspeakers against overload and possible damage?

In recent years, there has been a very noticeable escalation in the power output ratings of amplifiers intended for domestic use.

This has largely been the result of a transition to solid-state circuitry and to the development of output transistors with progressively higher power ratings, at little or no increase in cost. This has made it possible for designers to achieve progressively higher power ratings from domestic hi-fi stereo amplifiers, without the cost, heat and space penalties which would have attended any such efforts with valve circuitry.

Not surprisingly, something of a "power race" has resulted, with rival manufacturers offering and emphasising high power ratings, without too much regard as to whether such figures are necessary in an ordinary domestic situation.

Having had their attention focused on power output, it is again not surprising that purchasers should ask questions about loudspeaker ratings. If they purchase an amplifier rated to deliver 50 watts of continuous power per channel, would it not be logical to

couple it to two loudspeaker systems with a similar power rating?

The answer, undeniably, would be: "Yes, it would be logical, but..."

The "but" arises because effective high power ratings are not nearly as easy to achieve in wide-range loudspeaker systems as they are in wide-range amplifiers. There are likely to be severe penalties in terms both of cost and size.

While one can argue and speculate about the exact significance of loudspeaker power ratings, it is reasonable to assume that such a rating at least implies that:

(a) The loudspeaker will accept the full undistorted output of an amplifier capable of producing that amount of power on ordinary program material, including any likely content of heavy bass, sustained complex tones, and etc.

(b) The loudspeaker can be used under these conditions for lengthy periods without voiding any guarantee, suffering physical damage or reducing its effective "life" to an unreasonable period.

(c) The acoustic output will simultaneously contain no more inherent fre-

quency and harmonic distortion than envisaged in other ratings or implied by any description of the loudspeaker as a "high fidelity" unit.

(d) It will transduce the electrical power input to acoustic power output with an acceptable degree of efficiency.

This last point is most important in evaluating the relative merit of a loudspeaker system. If its acoustic efficiency is low, it may have a generous power rating simply because it needs more electrical input to produce a given physical — and acoustical — end-result.

Basic to the concept of a higher-powered loudspeaker is an assumption that it will be able to produce a higher level of sound than a more modestly rated unit. This means an increase in the amount of energy which it can couple to the surrounding air as sound wave — a task that becomes notably difficult in the bass register.

Translated into practical terms, the task of imparting increasing amounts of energy to the surrounding air may involve the use of progressively larger cones, able to move back and forth in linear fashion through the necessary distance.

Alternatively, if the cone size is restricted or even reduced in a higher-powered loudspeaker, the reduction in cone area has to be compensated by a considerable increase in cone travel, or the distance through which the cone can oscillate.

In either case, the combination of these escalating requirements with those normal to the design of a high fidelity loudspeaker results in a much more expensive unit, to which is likely to be added the extra cost of a larger, or more robust, or more elaborate enclosure. The end result is that, having purchased a high-powered stereo amplifier, many enthusiasts find that loudspeakers with comparable power ratings are more than they can accommodate, in terms of cost or space.

The question then follows as to whether they can use 50-watt amplifier channels with, say, 15-watt loudspeakers, these being the best they can afford.

Will the amplifier "blow up" their loudspeakers? If so, can they do something to limit the power output of the amplifier?

A suggestion that is sometimes made is to put a mark or a stop on the volume control so that it will not be turned past a certain point. In fact, this is not much help because of the varying nature of input signals, even from a single source. Say, for example, that the volume control was limited so that the amplifier would deliver a nominal 15 watts maximum on loud passages in a fairly lightly recorded record. It is entirely possible that the next record would produce double the signal input for the same volume control setting and therefore allow four times the power — or 60 watts — to reach the loudspeakers. Even greater difficulties might arise from signals of quite different level taken from tape deck of radio tuner.

Another idea sometimes put forward is to impose an artificial limit on the output of the amplifier by some sort of

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external peak clipper. Such a scheme could conceivably impose an artificial overload point at the 15-watt level but, in so doing, it would negate any advantage of buying the high-powered amplifier in the first place. Also, unless such a limiter was very carefully engineered, it would cause the output transistors to look into a very low value of load, possibly with disastrous results.

A still further possibility put forward is to make the loudspeakers only part of a total output load, the rest being made up of series and parallel high-dissipation resistors. While this would avoid any risk to the amplifier output stage, it would still completely negate any value of the high-powered amplifier, which would have to work "flat out" at 50 watts to drive the loudspeakers to 15 watts. For all practical purposes, the amplifier might as well have been a 15-watt unit in the first place.

A further point that should be made is that an amplifier which is able to deliver clean audio up to, say, 15 watts will be able to deliver a much higher output than 15 watts, if pushed into the overload region. This is true whether 15 watts represents the natural power limit of the amplifier or one that is artificially imposed.

In short, using a loudspeaker system only with an amplifier of equivalent power rating does not provide an automatic guarantee against at least nominal loudspeaker overload.

In fact, in the typical case, there is a good deal of justification for the idea that the best way around the difficulty is to rely, not on technical measures but on plain common sense.

It can probably be assumed that anyone installing a high-powered amplifier will provide it with loudspeaker systems having a power rating in the 10-15 watt range. Two such systems can provide more than enough level for a living room without running beyond their normal power rating. It therefore follows that, if the volume control is used in the normal way to provide no more level than is necessary in the home, even by generous standards, a pair of 10-15 watt loudspeakers will be quite safe, irrespective of the amplifier's maximum power rating.

In other words, it is not a question of marking the volume control setting but of simply turning it up only far enough on any given input, to provide the necessary (but logical) listening level.

The main reasons why 10-15W loudspeakers might be overloaded would be:

(a) If the owner turned up the volume to an extreme level to impress a visitor, or

(b) Turned up the volume with the bass control full on, just to feel the floor vibrate!

A further justification for relying on common sense is that loudspeakers are not prone to "instant" wrecking. If they are over-driven, the output will sound very distorted, particularly in the bass register. The voice coil may even "bottom" against the magnet structure. But, provided the overload condition is not sustained, the loudspeaker will seldom suffer any permanent damage.

In short, the owner can protect loudspeakers in the longer term by discreet use of the volume control. The loudspeaker's built-in tolerance will

(Cont. on page 189.)

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Micro MA-77 Mk. 2. arm . . \$44.50.

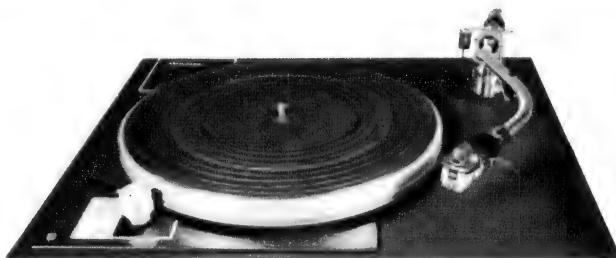
Micro magnetic cartridges set new performance standards for low-cost pick-ups! The Micro 3100/e cartridge with elliptical stylus features genuine low tip mass found only on far more expensive cartridges. Performance is particularly satisfying . . . separation exceeds 30 db at 1 KHz, frequency response is 20-28,000 Hz and is free of resonance throughout the audible range. Tracking ability of the 3100/e is excellent and the cartridge is extremely well shielded against external hum fields.

Micro 3100/e cartridge . . . \$24.50.

Connoisseur Turntables

Stocks of the new belt-drive turntables are once again in our store. Acceptance of these new models has been immediate and many were disappointed at missing out on our first shipment. Illustrated below is the **CONNOISSEUR BDI TURNTABLE**. It features a cast non-ferrous platter, well-shielded 14-pole synchronous motor and heavy-duty drive belt. Performance is outstanding—rumble, wow and flutter and hum radiation are extremely low. Price of the turntable in Kit form is only **\$33.50**. Also illustrated is the **LUSTRE ST-510D TONE ARM**. Constant demand indicates that the ST-510D is one of the most popular arms ever marketed in Australia. The curved S-shaped design ensures low tracking error and eliminates audible resonances. The low price of **\$24.50** includes an integrated hydraulic lift!

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Filter Set allows visible setting of frequency spectrum

Details of a new filter set which makes it possible to modify or shape the frequency spectrum of audio-range signals have been released in the U.S.A. by Hewlett-Packard.

The Hewlett-Packard Model 8056A Filter Set consists of 24 one-third octave filters connected in parallel. Each filter channel has an individually adjustable attenuator that allows the user to set the instrument's response to each one-third octave band of frequencies.

The primary purpose for filter sets such as these is in vibration testing. When connected to the output of a noise generator, a filter set can modify the noise spectrum to obtain signals representative of the type of vibration to which the tested equipment might be used in a real life situation; or the filter set can be used to compensate for deficiencies in driver or transducer frequency response. They are also used in sound reinforcement systems to compensate for the uneven frequency response of auditoriums and concert halls; and in recording and broadcast studios for modifying sounds.

The attenuators are adjusted by small thumbwheels that roll up and down to give a visual indication of attenuator settings and hence of the instrument's transmission characteristics. Each attenuator is continuously adjustable over a 40dB range which, because of gain provided in the instrument, covers a range of -20dB to +20dB. To compare a shaped spectrum with the unmodified spectrum, the instrument can be switched to function as a broadband, linear amplifier.

The new filter set can also be used with other instruments as a spectrum analyser: any one filter alone can be switched to the output for measurement of the signal level in that frequency band. For this application, a single front-panel pushbutton switches all channels to have 0dB gain, and another pushbutton switches all to 20dB gain. All the filter outputs are individually available simultaneously at a rear-panel connector, permitting use of the filter set in systems with automatic scanners.

Both input and output have selectable impedance: 600 ohm or 100K for the input, and 50 ohm or 600 ohm at the output. This arrangement simplifies applications of the Filter Set with a broad range of ancillary equipment.

In applications of a Filter Set to signal spectrum shaping, signal overload often is not easily recognised. A new, fast-acting overload circuit in the Model 8056A lights up if either input or output are overloaded for more than 0.1ms.

In its standard configuration, the Model 8056A has one-third octave filters with centre frequencies ranging from 50Hz to 10KHz. Other sets of filters, each spanning a 200:1 frequency range down to 2Hz or up to 40KHz, are available.



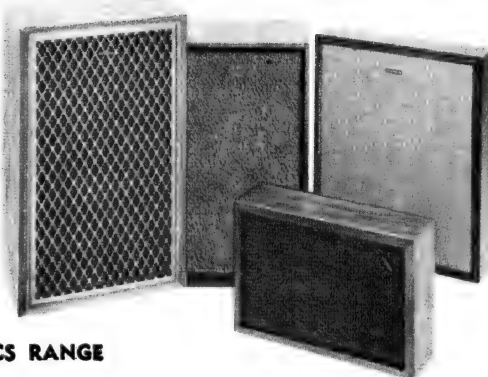
Hewlett-Packard Model 8056A Filter Set. Note how the settings of the attenuators give an indication of frequency spectrum.

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AS-61. This Slimline speaker (21 1/2" x 17 3/4" x 4 3/8") features four bass mid range speakers and a separate tweeter. In teak/walnut — with detachable legs. Encel's low price for this tremendously popular model includes sales tax.

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AS-303: This magnificent system, in hand finished teak or walnut enclosures, features three speakers with a 3-way crossover network: a 12" woofer (with long throw voice coil), 1 1/2" mid range speaker, and a horn type tweeter. AS-303 handles 15 watts (RMS); and produces high

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Extract from Review in the authoritative English "Audio Record Review," September 1969 issue.

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"Good response to above 20kHz and down to 35Hz was obtained."

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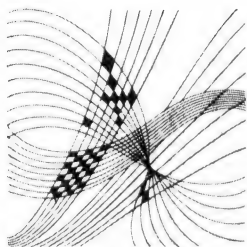
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CLASSICAL RECORDINGS

Reviewed by Julian Russell

BEETHOVEN—Fidelio Opera. Martti Talvela; Theo Adam; James King; Gwynneth Jones; Franz Crass; Edith Mathis; Peter Schreier. Dresden State Orchestra and Leipzig Radio Choir and Dresden State Opera Chorus conducted by Karl Bohm. DGG stereo 643614-6.

This year, to celebrate the bicentenary of Beethoven's birth, DGG has embarked on the enterprise of issuing his complete opus — a gigantic undertaking which, alas, to cover fully would not be practicable in the space at my disposal. I am therefore taking *Fidelio* as a sample and can state at the outset that if all the other issues are of this standard the collection will be rich indeed. The only other set I have heard worthy of comparison is the Klemperer, but since both conductors' readings differ and both have valid reasons for their own interpretations your preference will be wholly personal. Overwhelmingly in favour of the DGG set is Bohm's striking of what seems to me to be the perfect tempo for every item and attention to detail that never fails to illuminate the text. I can't remember when I have heard more accurate and expressive playing than that offered by the Dresden woodwind. The strings, too, have a fine big tone, but lack a little of the lustre of some of their colleagues in other fine orchestras. The brass, in tone and attack, are quite wonderful. On the other hand I find Klemperer's cast slightly more appealing than Bohm's in some of the roles — particularly those sung by Christa Ludwig, Walter Berry and Jon Vickers. But against this I can wholly endorse the youthful-sounding Gwynneth Jones (Leonore), who, despite a few very rare moments of uncertainty, offers a truly radiant performance. I liked, too, James King (Florestan), though in this role my allegiance goes to Klemperer's Vickers. I thought Theo Adam uninteresting as Pizarro, not comparable in any way to Walter Berry, but Franz Crass' Rocco is unremittingly appealing. There is nothing much to choose between those singing the smaller roles in both sets.

The Dresden choristers are superb and Bohm keeps the whole work moving steadily towards its climax in a manner that is never interrupted by achieving a momentary effect. Perhaps, as might be expected, Bohm's reading is not quite as massive as Klemperer's. You might think from what I have written that the DGG set is slightly inferior to its rival. This is in no way true. A little cooler, perhaps, and some-

times, rather surprisingly, a shade slower in tempo. But it has its own special virtues that I have tried to set out above in the space available—an item-by-item comparison would be as dull as it would be confusing — and some listeners might find that it is just the performance they have been waiting for. The sound is first rate and a well-bound libretto in English, French and German accompanies the boxed set of three records.

★ ★ ★

DEBUSSY — Iberia. Danses Sacrees et Profanes. Cleveland Orchestra conducted by Pierre Boulez. CBS Stereo SBR235344.

I am of the opinion that *Iberia* is Debussy's finest work for orchestra, though I am aware that there are many who might differ. It is technically perfect, imaginatively evocative, genuinely Spanish in atmosphere, and has, especially in the slow movement, perhaps the most ravishing theme Debussy ever wrote. I refer, of course, to the delicious oboe melody. I have frequently, in this column, described the Cleveland under their martinet director, George Szell, as the finest precision instrument playing today. And this is an opinion based not only on their recordings, but on having heard them live in Vienna, Amsterdam and other European capitals during the past few years. Boulez, if one excepts his astonishingly good performance of Handel's *Water Music* with the Hague Philharmonic a few years ago, has a somewhat limited repertoire in the record catalogue, but everything he records is admirable.

Iberia is no exception. And if, in the nature of things, the Cleveland horns have a little more body in them than is ideal for Debussy's sound, at least they don't produce the squashy timbre you get from many French orchestras. Boulez is not a showy conductor, nor is he over-careful or pedantic. Except for very rare deviations — I have in mind some of the vocal parts in his recording of Berg's *Wozzeck* — he observes the composers' desires with the utmost integrity. *Iberia* has been often recorded — I can recall an old 78 back in the late 1920s conducted by Lenau and, I think, the Paris Conservatoire Orchestra — and the different conductors have here and there used different tempos from the present reading by Boulez. But a glance at the score will reveal Boulez' accuracy in interpreting Debussy's intentions, not only in tempo, but in phrasing. For my taste, his is the best I have heard so far.

The only comparable account I can recall is that by Ansermet and the Swiss Romande, and the Cleveland players are way out in front of their Swiss colleagues in tonal quality and even in technique. This is not to disparage the Ansermet version (Decca), which still stands up very well to the closest scrutiny. But I prefer the new CBS.

On the second side are Debussy's *Sacred and Profane Dances*. This is not the first time I have heard Boulez conduct these two exquisite little pieces. In 1962, in Darmstadt, where I had been invited to attend the summer school for avant garde music, he conducted them, not for orchestra, but for a double string quartet consisting of the Parrenin and the La Salle with, of course, a solo harpist.

The odd thing to me was that an audience assembled to listen to the mind-fracturing exercises in avant garde sound encored the Debussy, and this the only work to be repeated during the whole of the 10 days and 10 nights course. His playing of them on this disc I found quite enchanting.

★ ★ ★

MUSIC TODAY VOLUME 9.

Busoni — *Berceuse Elegiaque*.

Wolpe — *Piece in Two Parts for Six Players*.

Dallapiccola — *Sex Carmina Alcaeï; Piccola Musica Notturna; Preghiere*. Heather Harper; Barry McDaniel. English Chamber Orchestra. New Philharmonia Orchestra conducted by Frederik Prausnitz. Record Society Stereo No. S 6327.

Strictly speaking, the Busoni *Berceuse* does not belong to this Music Today series, but rather to the world of late Mahler. It is a deeply moving piece of lyricism, reminiscent of the Mahler of the Ninth and Tenth Symphonies. It should offer no problems to those who accept Mahler as a recognised landmark in the development of what has become the standard repertoire. The other works are not so easy to appreciate at first hearing. Dallapiccola, despite his 12-tone technique, cannot quite shake off the innate Italian virtue of writing lyrically for the human voice. A deep conviction of the value of melody persists in spite of unswerving allegiance to more modern treatment. His *Piccola Musica Notturna*, which might be literally translated as *Eine Kleine Nachtmusik*, has periods of enchanting serenity punctuated by sudden outbursts of violence, the whole proving something a good deal worthier than just novelty.

The Alceus songs, though strictly formal in construction — a closer examination will disclose their canonic treatment — also have considerable charm enhanced by the beautiful and perceptive singing of Miss Harper, and to a slightly lesser extent, Barry McDaniel.

You will have to work much harder to get anything out of the Wolpe pieces, but if you are prepared to repeat them several times they will yield up unexpected eloquence.

The playing throughout the whole disc is beyond criticism — though I admit that I write this without having followed the music with a score. And

the magnificent fidelity of the sound reveals piquant sonorities which, on their own, should sustain interest until you familiarise yourselves with the music's other virtues. All three composers represented are somewhat outside the current trend of avant garde music. And although this doesn't make any of them accessible without some fairly intensive application, you should find much that is rewarding if you're prepared to use your mind as well as your ears.

★ ★ ★

DVORAK — Symphonic Variations for Orchestra. Serenade for String Orchestra in E Major. London Symphony Orchestra conducted by Colin Davis. Philips stereo SAL370X.

The Symphonic Variations are high up in the list of my favourite works of Dvorak. For that reason I had already welcomed this disc before I put it on my turntable. I was not disappointed. The Variations is great, gutsy music which still pays some small tributes to Brahms, but without any loss so far as I am concerned. Turn your volume control up a little higher than usual and, if your taste coincides with mine, you'll be in for a treat. The work is shamefully neglected on modern concert programs and has, as far as I can trace, only been recorded once before in recent times—back in the 1950s by Sargent. This makes the new version still more welcome. The 27 variations, unmistakably related to the theme so that there is no difficulty in following the composer's line of thought, are in varying mood — gay, serious, relaxed, dainty, forceful and graceful, with a rousing coda, extended as was invariably Dvorak's practice, that brings the whole to an exciting finish. It is obvious that all departments of the orchestra are having just the same whale of a time as the conductor.

If the variations appeal to you, you will be utterly charmed by the Serenade for Strings. It is a gentle work, persuasively lyrical and immediately rewarding. This, too, receives the most affectionate treatment imaginable from the LSO and Davis. By the way, the surface on this disc is very quiet, so that it is quite safe to turn up the volume without surface noise becoming tiresome.

★ ★ ★

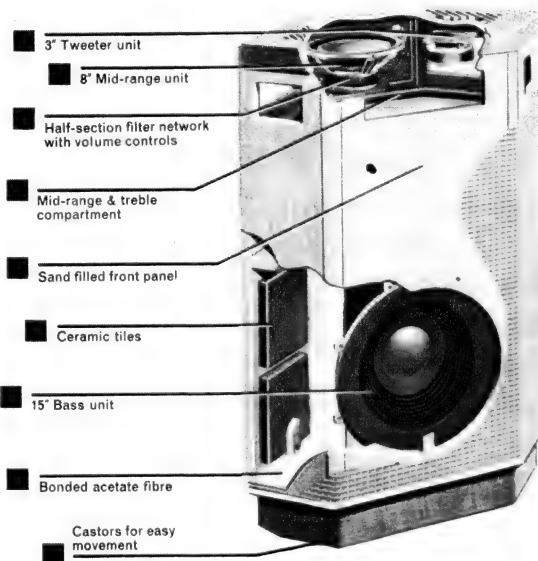
BRAHMS — Variations on a Theme by Haydn (St. Anthony). Variations on a Theme by Handel (arranged for orchestra by Edmund Rubbra). Philadelphia Orchestra conducted by Eugene Ormandy.

Unlike Dvorak's Symphonic Variations, Brahms' St. Anthony Variations can still be heard from time to time in Australian concert halls. I can't think why, though I admit that the Brahms is the more mature of the two. I don't have to tell you that the tone of the Philadelphia is much more luscious than that of the L.S.O. and that it suits the Brahms variations admirably. Faultless engineering and playing make these two pieces a most attractive disc. In the exhilarating "hunting" variation with its horn chorus, these instruments in the Philadelphia produce a real "Waldhorn" tone, quite unlike the

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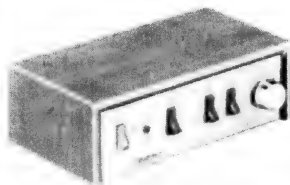
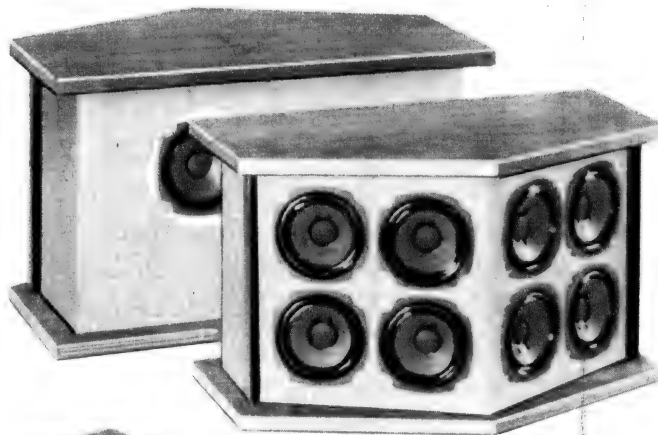
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dreamy, mysterious quality of English players or the rather squashy sound of the French. Ormandy gives each variation its own individual character while keeping the whole set consistently Brahmsian. His tempos are just right and the phrasing impeccable.

The Handel set is not so well known. It is for the most part more light-hearted than the St. Anthony in a manner unusual for Brahms. The scoring, too, is unlike that found in most of the master's other works: There is little of his customary thickening of the inner parts. Instead you can sometimes find a hole in the middle, producing a clear top and bottom sound favoured by more recent composers. It starts with some brilliant trumpet playing of the theme — trills and all — follows this with a dancing oboe and goes on for the most part in a happy progress toward its satisfying coda. Thoroughly recommended to the more orthodox minded collector. I doubt if a better will appear for a very long time.

★ ★ ★

MEISTER IHRES INSTRUMENTS
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Vol. 1, Stefan Askenase.

Mendelssohn — Songs Without Words
in E Major, C Major and A
Minor; Scherzo in E Minor.

Schubert — 12 Ländler and Waltzes.

Liszt — Liebestraum No. 3 in A Flat
Major; Valse Oubliée in F Sharp
Major.

Chopin — Scherzo in B Flat; Berceuse
in D Flat Major; Barcarolle in F
Sharp Major. DGG Stereo 135130.

I cannot work up much enthusiasm for the pedantic playing of this record. The Bee's Wedding tends to plod with affected accentuation. And Askenase — not to be confused with Vladimir Ashkenazy, a younger and more brilliant pianist — makes Schubert's charming Ländler and Waltzes a solemn experience. On the other hand, I think most listeners will approve the Liszt Liebestraum despite Askenase's slight hesitations at the cusps of phrases. Again he makes Chopin's Berceuse altogether too serious an experience with even the tendril-like decorations too studied to add much in the way of sheer enjoyment of their spontaneous generation. Liszt's Valse Oubliée receives a run of the mill performance, scholarly rather than charming. Although I found the whole disc very much lacking in humanity those seeking nineteenth century romantic music treated with unrelenting earnestness might well approve of this type of playing.

The piano tone has a longish reverberation period which takes a little getting used to, but the ear soon adjusts to it.

★ ★ ★

MOZART — Symphony No. 41 in C
Major (Jupiter). Symphony No. 31
in D Major (Paris). English Chamber
Orchestra conducted by Daniel
Barenboim. HMV Stereo
OASD 2379, Series 575.

When Daniel Barenboim started to conduct — at that time his reputation as a phenomenally gifted pianist was already secure — he was lauded by most critics and laymen alike. Now doubts have started to creep in, espe-

cially about his Mozart. And purists who listen to his latest Mozart offering are in for a treat picking faults in style in these two, to me, impressive performances. But that they are valid interpretations — and exciting ones — few would be hidebound enough to deny. Both have enormous vitality with a just measure of delicacy and refinement. In the English Chamber Orchestra he is conducting one of the very finest combinations of its kind in the world today. And — a detail perhaps, but an important one — Barenboim uses it with such careful attention to balance that the bass line, always significant in Mozart's works, neither fades into obscurity nor is treated perfunctorily.

Barenboim offers no formal prettification. All the music is deeply felt and expressed. Some of his tempos are unusual; I found them all completely convincing. Moreover, he uses an orchestra of true Mozartian proportions. In the first movement of the "Paris" the rapidly changing moods are all registered with unflinching fluency. And I find the middle movement, the Andantino, utterly satisfying, too. True he takes the Finale at a much brisker pace than usual, and the orthodox never tire of reminding us that Mozart detested his music being played too fast. Barenboim makes it presto rather than allegro, but he sweeps the listener along with him irresistibly and the E.C.O. get through it without a smudge. Even at Barenboim's pace no note ever treads too closely on the heels of the next, and the phrasing remains intact and elegant.

But it is Barenboim's treatment of the "Jupiter" that will probably cause eyebrows to rise the most. His only consideration seems to have been to have the music played exactly as he thinks it should sound and to the devil with tradition. But whatever you may think of a moment here and there in the first movement, the slow movement will be a joy to all but the most prejudiced; and the Minuet gets up on to its points to dance. The monumental Finale is, to express its appeal to myself in one word — magnificent. By the way, have you ever noticed that the first four notes of the fugal passage — C, D, F, E — are the key signatures of the four Brahms symphonies in their chronological order? I wonder if this was accidental. At any rate, summing up these two performances I must repeat that, if you are prepared to accept readings that do not slavishly follow tradition, they will certainly be for you. And the sound is perfect too.

★ ★ ★

MONTEVERDI — Madrigals and
Other Vocal Works. Ilse Wolf;
Robert Tear — Berald English;
Christopher Keyte; with a section
of the English Chamber Orchestra
conducted from the Harpsichord
by Raymond Leppard. Record
Society Stereo NO. S/6326.

It is a pity that this enchanting disc of vocal music is not accompanied by a copy of the texts. In all there are 12 separate items, all of them beguiling, many of them quite disarmingly beautiful. I regret that with the space available to me here it is impossible to list them all. I can however help with a brief outline of what you can hear.

It is all secular, and most of it of the

more voluptuous type. Many of the pieces show Monteverdi's unflinching sense of the dramatic when necessary. The works chosen all come from the period 1607-1651. Among the earliest are the now famous Scherzi Musicali, at any rate seven of them. I think you will find their dancing rhythms quite irresistible. Some of the 12 items are for solo voice, others call for two or more singers. All are beautifully sung. And Raymond Leppard makes a contribution of unquestioning value with his harpsichord continuo.

The original disc was issued under the L'Oiseau Lyre label and the sound is consistently first rate. This is a record I can recommend with the heartiest enthusiasm.

(EDITORIAL NOTE. Since this review was set in type we have learned that a text is supplied with this disc, but was apparently not supplied with the review copy.)

★ ★ ★

RAVEL — Bolero; Rapsodie Espagnole; Daphnis et Chloé (Suite No. 2); Pavane pour une Infante Defunte. Orchestre de Paris conducted by Charles Munch. HMV Stereo OASD2497.

So far, the Orchestre de Paris, founded with the blessing of General de Gaulle when he was in power and well advertised as promising great things, has not lived entirely up to expectations in its recordings. I heard the orchestra live under Barbirolli in Strasbourg last year, where they played the first half of the program — a Berlioz overture and the three Debussy Nocturnes — like angels. But in the second half they blared their way into mediocrity in as disappointing a performance of the Brahms Fourth Symphony as I have ever heard. This new disc has its good as well as its commonplace features.

In Bolero, taken slower than usual — no fault this because it gives the single theme a sinuous effect — the side drummer, who repeats the same four bars, the first two slightly different from the third and fourth, during the whole duration of the piece, momentarily loses control of the rhythm, something I've been waiting to happen for years, but hear it for the first time here. But that is its only blemish. Munch makes the Pavane sound more like a lament than a stately dance, though it is most sensitively played in this form, one harmony moving so smoothly into the next that you are almost unaware of the change. It may interest some to learn that the "dead Infanta" words in the title were an afterthought of Ravel's. He was so enamoured of the different French nasal sounds in the words "une Infante Defunte" that he added them to the title Pavane. I think this is the piece in which the Orchestre de Paris can be heard at its best on this new disc.

Both the Rhapsodie Espagnole and the second suite from the ballet Daphnis and Chloé suffer from lack of tension and slackness of propulsion. But another point in this disc's favour is the amount of playing time that is got on to the two sides. This even makes the turnover at the end of the first movement of the Rhapsodie Espagnole quite excusable.

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IRELAND — These Things Shall Be, for baritone solo, chorus and orchestra. John Carol Case and the London Philharmonic Orchestra and Chorus conducted by Sir Adrian Boult. Concerto in E Flat Major for Piano and Orchestra. Eric Parkin and the London Philharmonic Orchestra conducted by Sir Adrian Boult. World Record Club S/4668.

A record of John Ireland's music is something of a rarity nowadays and I do not think the choral work, These Things Shall Be, a particularly happy choice for inclusion. The words used by Ireland — a poem by J. A. Symonds — is no better than banal, and the Concerto which is also featured on the disc proves that Ireland had better music in him than you would guess from the choral piece. But whatever the quality of the music the recording is very good indeed, the London Philharmonic Chorus has never sung better, and John Carol Case is fine in the baritone solo. But to me the concerto makes the whole disc worth while even if you never play its coupling. This is Ireland at his best, full of picturesque imagination, technically of unfailing interest, and immediately attractive in its profusion of handsome melodies.

It is admirably played by the LPO under Boult and the playing of the solo part by Eric Parkin is so good that it clamours for more of this splendid pianist's work to be recorded.

★ ★ ★

MENDELSSOHN — Symphony No. 5 in D Minor (Reformation).

SCHUBERT — Symphony No. 5 in B Flat Major. New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235341.

A new recording of the "Reformation" has long been overdue and it is with pleasure that I can recommend this one. It offers Bernstein in respectful mood. He doesn't destroy the pious atmosphere of the first allegro by indulging in frenzied climaxes, but preserves a respectful spirit of acclamation. The symphony was composed to commemorate the tercentenary of the Augsburg Confession, the official declaration of the Lutheran churches written in 1530. Mendelssohn was only 20 when he composed it. It is also of interest that it makes use for the first time in a composition of any weight of the famous Dresden Amen, later used by Wagner in Parsifal. Remembering the religious origin of the symphony, it is as much at home here as in the music drama.

I was particularly impressed by Bernstein's treatment of the Scherzo which he doesn't make sound too fragile. It remains slightly solemn, thus keeping it within the spirit of the rest of the composition. There is no chasing of a Midsummer Night's Dream Overture atmosphere. Bernstein exercises still more restraint in the lovely slow movement, using it as a prelude to the fine Finale where the true climax of the symphony is to be found. Here again Bernstein makes no attempt to add alien sparkle. His reading has true Lutheran sternness.

There is no lack of good recordings

(Continued on page 190)

CLASSICS ON CASSETTE TAPE

Steadily increasing demand is resulting in a wider repertoire of available classical cassettes, most of them issued by the Philips-DGG group.

But those to whom this — perhaps the handiest form of recorded music ever devised — is new must not expect cassettes to provide truly "hi-fi" reproduction. Connected to a good amplifier and speakers they will give you about the same quality reproduction as a better-class commercial radiogram. This quality has improved since cassettes were first introduced some years ago, much of the background noise has been eliminated, and it is to be expected that still more improvements will be made in the future. In the meantime they provide the handiest way to store and play recorded music. Their future, in my opinion, is now well assured.

★ ★ ★

MOZART — Concerto for Flute, Harp and Orchestra. Hubert Barwahser (flute); Osian Ellis (harp); and the London Symphony Orchestra conducted by Colin Davis. Clarinet Concerto. Jack Brymer (clarinet) and the L.S.O. conducted by Colin Davis. Philips CPC0012.

To get the best result from the first concerto it is advisable to cut your normal bass a little and increase the treble. The balance of the harp suffers from similar prominence as in the disc version, a little too much resonance in the middle register and some weakness at the very top. But this does not prevent admirable reproduction of lovely crystalline sound in the harp part. The flute solo is excellent, and the playing of all concerned, soloists and orchestra, under Davis, is splendid. Notice particularly the beautifully steady flute tone in the slow movement.

In the Clarinet Concerto, keep the treble at the same setting, but set the bass to normal. Brymer gives the most beguiling performance imaginable of the solo part, cooing away with enchanting tone. Tempos are perfect for my taste and the whole performance is in perfect style. Clarinet players will notice that Brymer leads back in the slow movement with a phrase of his own and not with the usual loan from the Clarinet Quintet, with, I think, the happiest of results.

★ ★ ★

PROKOFIEFF — Piano Concerto No. 3 in C Major.

RAVEL — Piano Concerto in G Major. Martha Argerich and the Berlin Philharmonic Orchestra conducted by Claudio Abbado. DGG 923040.

I have never come across these two excellent performances in disc form. Also it is my first meeting with the solo pianist, Martha Argerich, who, judging by her photograph on the cassette container, is as handsome as her playing. Again you will find a longer than usual reverberation period, but not protracted enough to cause any serious worry. I

hope I will not be thought patronising when I say that I would never have picked Miss Argerich's playing as a woman's. The forceful authority of her fast passages is matched by the sensitivity of the more delicate ones. She has, moreover, a range of sonorities that even the late Walter Gieseking might well have admired. Notice particularly the delicate perception of her handling of the long Bach-like aria in the slow movement of the Ravel and in the following figurations. Everywhere she is treated like an equal by the orchestra and conductor.

Her reading of the Prokofieff is essentially romantic when the percussive approach of most other pianists is recalled. I don't mean by this that you will hear any wilful distortions and alien rubatos. Every note has gem-like separation and in the first movement this produces sparkle without pugnacity. In both concertos Miss Argerich displays a very wide dynamic range, always under unshakeable control. Very strongly recommended.

★ ★ ★

BRAHMS — Violin Concerto in D Major. Arthur Grumiaux and the Concertgebouw Orchestra conducted by Eduard van Beinum.

BEETHOVEN — Violin Romance No. 1 in G Major. Same performers conducted by Bernard Haitink. Philips CPC0013 (05).

This makes an interesting cassette to compare with the previous one because of the thicker quality of Brahms' scoring. The cassette must have been made from a fairly old recording because van Beinum has been dead some years now. But it carries its age very well indeed so far as recording quality is concerned. Compared to the unremitting drive most great violinists bring to this concerto Grumiaux's reading is beautifully lyrical with quite heavenly moments in such passages as the one just before the end of the first movement where Brahms is at his most feminine. But good as the performance is, I think it might be worth while waiting until another of equal merit but more modern in recording technique becomes available. Myself, I'm quite happy with it. Grumiaux's is the sweetest interpretation of this heavyweight concerto I have ever heard.

The Beethoven Romance is of much more recent origin and can be recommended without any of the technical qualifications mentioned above.

★ ★ ★

VIVALDI — The Four Seasons. I Musici. Philips CPC0002.

The sound here is excellent. It has admirable clarity with a wide range of frequencies and dynamics. This early eighteenth century music, as played by I Musici, is perennially fresh; and this distinguished group are at once alert

and poetic. The only minor criticism I can make of this first rate issue is that I would have liked to hear a little more of the harpsichord continuo. Otherwise even the most carping of critics will find themselves in for a very pleasant experience.

★ ★ ★

MOZART — Piano Concertos Nos. 12 in A Major and 16 in D Major (K.414 and 451). Geza Anda and the Camerata Academica des Salzburger Mozarteums conducted by Geza Anda at the piano. DGG932005.

The sound in this at normal setting is a wee bit plummy but can be considerably improved by a hefty treble boost. The playing in both concertos is in what has become to be recognised as orthodox Mozartian style — smooth, never too heavy, and concentration on clarity of line and unemphasised inflections. If you make allowances for the small matters mentioned above you should find this cassette eminently acceptable.

★ ★ ★

MENDELSSOHN — Symphony No. 4 in A Major (The Italian). Symphony No. 5 in D Major (The Reformation). Berlin Philharmonic Orchestra conducted by Lorin Maazel. DGG923013.

After the brilliance of the sound in the previously reviewed cassette (The Four Seasons), it is noticeable that this one lacks something in the way of high frequencies. But I found my ear soon adjusted itself to their absence. Maazel attacks the first movement of the "Italian" with great spirit and despite its speed manages to win perfect articulation and phrasing. It is all most exhilarating, approached in precision only by the Cleveland under Szell. Maazel doesn't dawdle over the "Pilgrims' March" in the second movement and the following minuet is as graceful as anything he has ever conducted. At one spot the woodwind fairly gurgles with delight. Yet all is handled with smiling restraint. The sparkling "Neapolitan" Final goes with even more elan than the first movement without any sign of a scramble. Breathtaking perfection of performance.

The "Reformation" is a much more austere work without the exuberance of the "Italian." It was interesting to compare Maazel's reading on this cassette to Bernstein's disc reviewed in the classical record section this month. Although there are minor differences of interpretation both conductors achieve solemnity without pompousness. Surprisingly — at any rate, to me — Maazel's is the more romantically handled. He doesn't seem to be watching himself so carefully as Bernstein and abandons himself without reserve to the delights of the dancing second movement. The tonal quality of the Maazel is a trifle woolly at times and in the Finale sounds slightly overloaded. But whatever details you may find to criticise in the "Reformation" I can guarantee your complete satisfaction with the "Italian." ■

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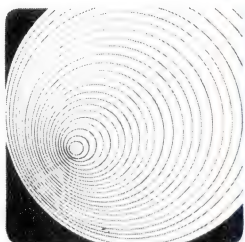
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By HARRY TYRER, FORBES CAMERON, NEVILLE WILLIAMS

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THE GLORY OF GABRIELLI, Vol. III (Music for A Capella Choir). C.B.S. (Australian Record Company) stereo SBR 235349.

Interest: Renaissance music of the Catholic Church.
Performance: Outstanding.
Quality: Well recorded.
Stereo: Well spread.

The idea of recording Gabrielli's music for unaccompanied choir (a cappella) in the environment where it was written and first performed was apparently not for reasons of sentiment or affectation. Gregg Smith, the musical director of this group, believes that it can only sound natural under these circumstances — and who will dispute the issue with him after hearing these glorious performances: Admittedly the all professional choir is technically excellent, but the wonderful acoustic atmosphere in this recording leaves no doubt in my mind that Greg Smith is entirely right in his suppositions.

Gabrielli was a church composer, and wrote mainly music for church performances. Most of the items here are liturgical, comprising: Deus, in Nomine Tuo (from Psalm 53)—Beata es, Virgo Maria (Antiphon for the Magnificat)—Jubilemus Singuli (Hymn to St. Mark)—Deus, Deus Meus (from Psalm 62)—O Quam Suavis Est (Antiphon for the Magnificat) — A Capella Mass: Kyrie, Sanctus; Benedictus—Cantate Domino (Psalm 95)—Domine Exaudi (Psalm 101)—Hodie Completi (Antiphon for the Magnificat). Listening to this glorious music sung so

expertly was a moving experience for me, as I am sure it will be to anybody who has any acquaintance with the music of the Catholic Church, or anybody else, for that matter, who appreciates fine singing of liturgical works. (H.A.T.)

★ ★ ★

AMEN, The 130-voice Choir and Choral of the First Baptist Church of Van Nuys, California, directed by John Gustafson. Stereo, Light, LS-5505-LP. (From Sacred Productions Aust., 181 Clarence St, Sydney, and other capital cities.)

Interest: Hollywood-style choir.
Performance: Excellent in its class.

Quality: Good.
Stereo: Normal.

Air-conditioning and plenty of reticulated water have transformed the hot and dry San Fernando Valley into a fashionable residential area, away from the coastal smog of Hollywood and Los Angeles. The First Baptist Church of Van Nuys would appear to reflect the prosperity of the community with its 8,000 members, 31 choral groups, involving 1,300 singers and, at the head of it all, that very accomplished Gospel musician, John Gustafson.

From this background one would not expect to hear anything but the best and, in fact, solo voices, massed voices, and orchestral voices combine to present a highly polished performance. But, as noted above, there is a dramatic, all-American quality about the presentation that some will relish and

others will dislike. One almost looks for the screen and the climactic ending to match the sound that issues from the stereo loudspeakers.

The titles: Amen — Rock Of Ages — All Hail The Power — Oh For A Thousand Tongues To Sing — The Old Rugged Cross — Peace In The Valley — America The Beautiful — I want to Be Ready — It Is No Secret — Jacob's Ladder — Take My Hand Precious Lord — Amazing Grace.

A very well produced record in its class but one that would not necessarily please those with more conservative ideas of choral music. (W.N.W.)

★ ★ ★

SACRED SONGS, June Bronhill with the John McCarthy Singers. Organist Brian Stanborough. Conducted by John McCarthy. Stereo, Columbia SCXO-6359.

Interest: Well known singer, music.
Performance: Thoroughly enjoyable.

Quality: Excellent.
Stereo: Normal.

June Gough, whose stage name is a constant reminder of her home town, Broken Hill, N.S.W., has enjoyed considerable success in England, Australia and South Africa. Her stage successes have included "Merry Widow," "Robert and Elizabeth," "The Dancing Years" and "Sound Of Music."

Here, with the John McCarthy Singers, she presents a generous 50-minute program of well known sacred songs, which should find plenty of ready buyers: Nuns' Chorus — Flocks In Pastures Green Abiding—Easter Hymn — Ave Maria — O For The Wings Of A Dove — Nearer My God To Thee — Bless This House — Largo — Agnus Dei — The Holy City — O Divine Redeemer — Abide With Me.

The soloist's diction and phrasing are excellent, likewise the arrangements and backing, while those with an ear for the pipe organ will enjoy the work of Brian Stanborough. A record you can buy with confidence. (W.N.W.)

★ ★ ★

MARCY SINGS "Jesus Loves Me" and Fourteen Other Songs. Mono, Word K-704. (Available from Sacred Productions Aust., 181 Clarence Street, Sydney and other capitals).

Interest: Very, very young children.

Performance: Unique.
Quality: Excellent.

To say I was surprised, when I put this album on the turntable, would be to put it mildly. The portrait on the cover is that of a mature woman, Marcy Tigner, but the voice that emerges from the loudspeaker is that of a little child, with child-like pronunciation and the child-like struggle to reach notes which are just beyond its register.

The paradox is explained by the jacket notes which indicate that Marcy Tigner is a musician and ventriloquist and that the voice is supposed to belong to a little girl doll, which is featured regularly on U.S. television and radio.

The fourteen hymns and choruses are well known and typical of those which would be enjoyed by children in Sunday School kindergarten departments. And this, I imagine, would be

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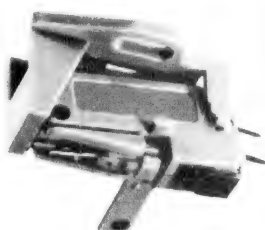
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the natural place where the record could be put to best use. Either that, or in homes where there are small children who have been taught these particular hymns and choruses. But I wouldn't recommend it for general listening. The price, by the way, is \$2.50 (W.N.W.)

Instrumental, Vocal and Humour . . .

POPULAR STRING MUSIC, conducted by Sir Malcolm Sargent, with the Royal Philharmonic Orchestra. World Record Club stereo S/4614.

Interest: Tuneful classics.
Performance: Hard to fault.
Quality: Good.
Stereo: Limited spread.

This disc gave me a session of pure delight from start to finish. It is virtually pure melody all through, and beautifully played by the strings of the Royal Philharmonic Orchestra under the baton of the late Sir Malcolm Sargent. The Dvorak "Serenade for Strings" (op. 22, in E major) is one of that composer's happiest inspirations, written at a time when he was experiencing the first flush of success. Its glowing beauty has ensured its success with concertgoers (and record buyers) in all parts of the world. This is followed by Peter Warlock's "Capriol" Suite, a set of charming miniatures based on ancient dance pieces. Although written as late as 1926 it has no trace of the aggressive modernism which was sweeping the world of music at the time. Finally, there is Gustav Holst's popular "St. Paul's Suite," written in 1913 for performance by pupils of the St. Paul's Girls' School where he taught music for a large part of his life. It has been a firm favourite ever since he published a version for string orchestra. The last movement is perhaps best known, its popularity being due to the inclusion of the familiar "Green-sleeves" melody.

The recording quality is adequate, the sound being clean and bright, but dynamic range is not wide. The stereo spread is even but slightly restricted. All in all, a "safe" record which should have wide appeal. (H.A.T.)

★ ★ ★

THE ENJOYMENT OF OPERA.
Vol. 1. Various artists and orchestras. His Master's Voice. Stereo SOELP 9588.

Interest: Opera sampler.
Performance: Top ranking artists.
Quality: Good throughout.
Stereo: Some variation.

Recently I reviewed "The Enjoyment of Music" in the same series, and gave it the strongest possible recommendation. I was therefore delighted to receive this, which I took to be a companion disc. However, it appears that this disc (and presumably volume 2 to follow) has a rather more definite purpose in mind than the earlier release. The sleeve note reveals that the disc was prepared to provide sound illustrations for the book by Alan Blythe, also called "The Enjoyment of Opera" (Oxford University Press). "Most items are specifically referred to in the book"

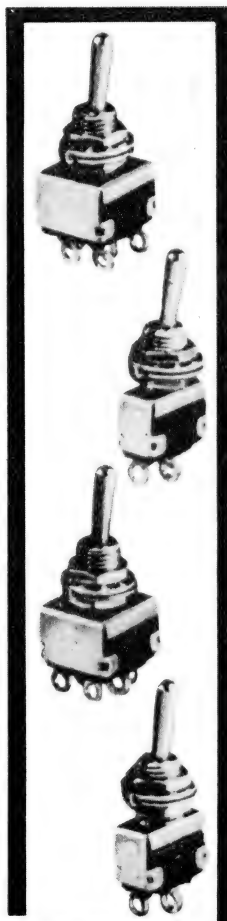


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7052/K20	7062/K20	ON	OFF	ON*
7053/K20	7063/K20	ON	NONE	ON
7054/K20	7064/K20	NONE	ON	ON*
7055/K20	7065/K20	ON	NONE	OFF

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† Keyway position

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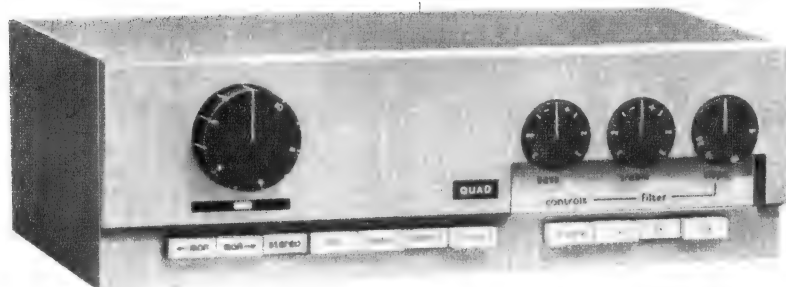
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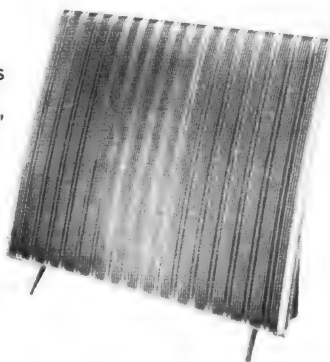
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we are told. This accounts for some of the rather unusual selections to be found here, such as the recitative secco (i.e., without orchestra) "Per Carita" from "Cosi Fan Tutti," and the flamenco section of "La Vida Breve."

Space does not allow a full listing of the items and artists included, but here is a rundown of the work represented and the heading under which they appear: Costi Fan Tutti (recitative secco) — Dido and Aeneas (accompanied recitative) — Otello (seamless music drama) — Boris Godounov (expression of feeling) — The Flying Dutchman (duet) — Fidelio (quartet) — Aida (big ensemble) — Il Seraglio (comedy of character) — Falstaff (comedy of situation) — Don Pasquale; Les Troyens a Carthage; Tristan and Isolde (love duets) — Der Freischutz; A Life for the Tsar; The Bartered Bride; La Vida Breve (romanticism and nationalism). These extracts are all from top ranking performances in the E.M.I. catalogue, featuring exclusively world famous artists. As such, the disc represents wonderful value at \$2.50, and is another superb public relations exercise by the E.M.I. organisation. (H.A.T.)

★ ★ ★

STRAUSS WALTZES OF VIENNA.

Royal Philharmonic Orchestra, conducted by Sir Malcolm Sargent. Music for Pleasure, compatible stereo MFP-A9031.

Interest: Viennese waltzes.

Performance: Unrelaxed.

Quality: Dated.

Stereo: Restricted.

Apart from its low-price tag, there is very little one can say in favour of this disc. Even then, one has to bear in mind the numerous excellent recordings of the music of Strauss reviewed in these columns in recent issues, on low price labels. Here, the orchestra sounds very stiff, and self-conscious, and do not appear to be enjoying the experience one bit. The sound quality is dated, and the restricted dynamic range is very noticeable. To cap it all, the playing time is by no means generous. Only five items are included: Tales of the Vienna Woods — Emperor Waltz — Blue Danube Waltz — Wine, Women and Song — Artist's Life. I cannot really recommend this one, even at the low price. (H.A.T.).

★ ★ ★

MANUEL AND THE MUSIC OF THE MASTERS. Manuel and his Orchestra. Studio 2, Stereo (E.M.I.) TWO 284.

Interest: Light orchestral.

Performance: Very pleasing.

Quality: Excellent.

Stereo: Very noticeable.

For those with a taste for Palm Court style music, here is an example par excellence which cannot fail to please. This group has previously been featured as Manuel and his Music of the Mountains, and I am glad to see this appellation has been dropped, since it tends to be misleading. The faintly hillbilly air of the title certainly does not do justice to the excellence of their playing. Apart from the high standard of musicianship, I must comment on the skill of the arranger, credited in the titles simply as "Love." The labours of Love in this selection have resulted in some very pleasing tracks, and in particular I was impressed by his treatment of the Adagio Cantabile move-

ment from Beethoven's "Pathétique" sonata. This is the only satisfactory arrangement of this piece for orchestra I have encountered in many years of listening. Some of the other arrangements are almost equally successful.

The selection comprises: Sonata Pathétique, slow movement (Beethoven) — Etude, Op. 10, No. 3 "Tristesse" (Chopin) — Barcarolle (Offenbach) — Liebestraum (Liszt) — Waltz from "Serenade for Strings" (Tchaikowsky) — Prelude to Act III from "La Traviata" (Verdi) — Chanson Triste (Tchaikowsky) — Andante Cantabile (Tchaikowsky) — Largo (Handel) — Humming Chorus from "Madame Butterfly" (Puccini). The last item reminds me that a humming chorus is featured in several tracks to good effect. (H.A.T.).

★ ★ ★

WHIRLWIND OF WALTZES. Raymond Lefevre and his Orchestra. Riviera (Festival), Stereo SRVL-933,259.

Interest: Short form Strauss.
Performance: Pleasing style.
Quality: Very good.
Stereo: Normal.

Strauss waltzes come in two sizes — the full length version complete with preludes and postludes, as favoured by full symphony orchestras, and the shortened versions for light orchestra performance, playing the main themes only, often without repeats. As there are no less than 12 Strauss waltzes here it is not surprising to find they are the shortened versions. The results are pleasing enough, nicely played by a largish light orchestra, and skilfully arranged, so if you find the full-dress versions overlong, as some people apparently do, this could be to your taste. All the best-known Strauss waltzes are there: Voices Of Spring, Blue Danube, Vienna Woods, Treasure, Roses of the South — need I go on? The Riviera label is one I have not previously encountered, and is presumably a new one in Australia. Technically, it is entirely satisfactory. (H.A.T.).

★ ★ ★

GREAT LOVE FILM THEMES. Various orchestras. Universal Record Club. Stereo U-1033.

Interest: Film music.
Performance: High standard.
Quality: Excellent.
Stereo: Normal.

Some of the best modern film themes are included in this selection, mostly represented by original sound track music or by an orchestra using the original film score. The rest are from United Artist's records of recent vintage. Whatever the source, the playing is of high standard throughout. From the original sound track are themes from: Irma la Douce — A Man and a Woman — Modern Times — Goodbye Again — Phaedra — Tom Jones. Original scores are used for: The Thomas Crown Affair — Fitzwilly Strikes Back — Hawaii. Duo pianists Ferrante and Teicher, with orchestral backing, contribute two tracks in their usual polished style: Love Is a Many Splendoured Thing — A Summer Place. The very generous helping of 14 tracks is completed by: Moon River (Breakfast at Tiffany's) — To Sir with Love — Love Theme from Romeo and

Juliet. The sound quality is excellent throughout, and even the music from the 1936 "Limelight" sound remarkably good for its age. (H.A.T.).

★ ★ ★

ALOHA HAWAII. The Waikiki Beach Boys. Stereo, Music For Pleasure. MFP-A 8109.

Interest: Happy island sound.
Performance: Bright.
Quality: Good.
Stereo: Plenty of separation.

Island music seems to have its own relaxing charm, whether played by three or four native musicians or by a larger group in a strictly commercial environment. The Waikiki boys make free use of an organ and other electronic aids, and their tempi are even and danceable, but the sound, as I said, is pleasant and relaxing. They play: Tiger Shark — Beyond The Rainbow — Sophisticated Hula — Pearly Shells — Little Heaven of the Seven Seas — Hawaiian Cha Cha — Sarawaki — Ua Like No A Like — Little Brown Girl — Blue Tahitian Moon — The Hukilou Song — Aloha Oe. Playing time is about 40 minutes.

Excellent value if you like island music. (W.N.W.)

★ ★ ★

JOE LOSS PLAYS GLENN MILLER. Music For Pleasure. Stereo MFP-A 8092.

Interest: Faithful recreations.
Performance: Well played.
Quality: Bright recording.
Stereo: Normal separation.

The music of Glen Miller is currently at a peak of popularity in England, mainly through the untiring devotion of the Syd Lawrence Orchestra. In addition, the Glen Miller Orchestra, as such, still functions successfully in America.

This LP is a further contribution to the continuing legend of Glenn Miller, with English bandleader Joe Loss leading his Orchestra through twelve of Miller's most popular numbers.

They include, for example, "Moonlight Serenade," "American Patrol," "Little Brown Jug," "Tuxedo Junction" and "String of Pearls." The arrangements are faithful to Miller, the vocals are competent and the Joe Loss Orchestra is a well-drilled, efficient dance band.

Nostalgic lovers of Glen Miller's music may find the L.P. appealing, particularly at the MFP budget-price of \$1.99. In the final analysis, however, recreations are a poor substitute for the original. (T.F.C.)

★ ★ ★

YE-ME-LE. Sergio Mendes and Brasil '66. A. & M. Records (Festival) stereo SAML-933,614. Available in mono.

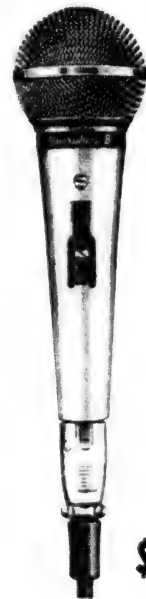
Interest: Bossa Nova.
Performance: See review.
Quality: Excellent.
Stereo: Three-channel type.

Record critics have been complaining for some time that the cool and elegant lead singer of this group, Lani Hall, has not been accorded enough recognition for the major contribution she makes to its success. Here, for the first time, she is allowed to dominate in some tracks, instead of being held in a sup-

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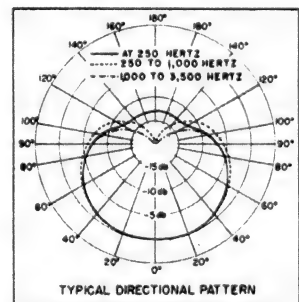
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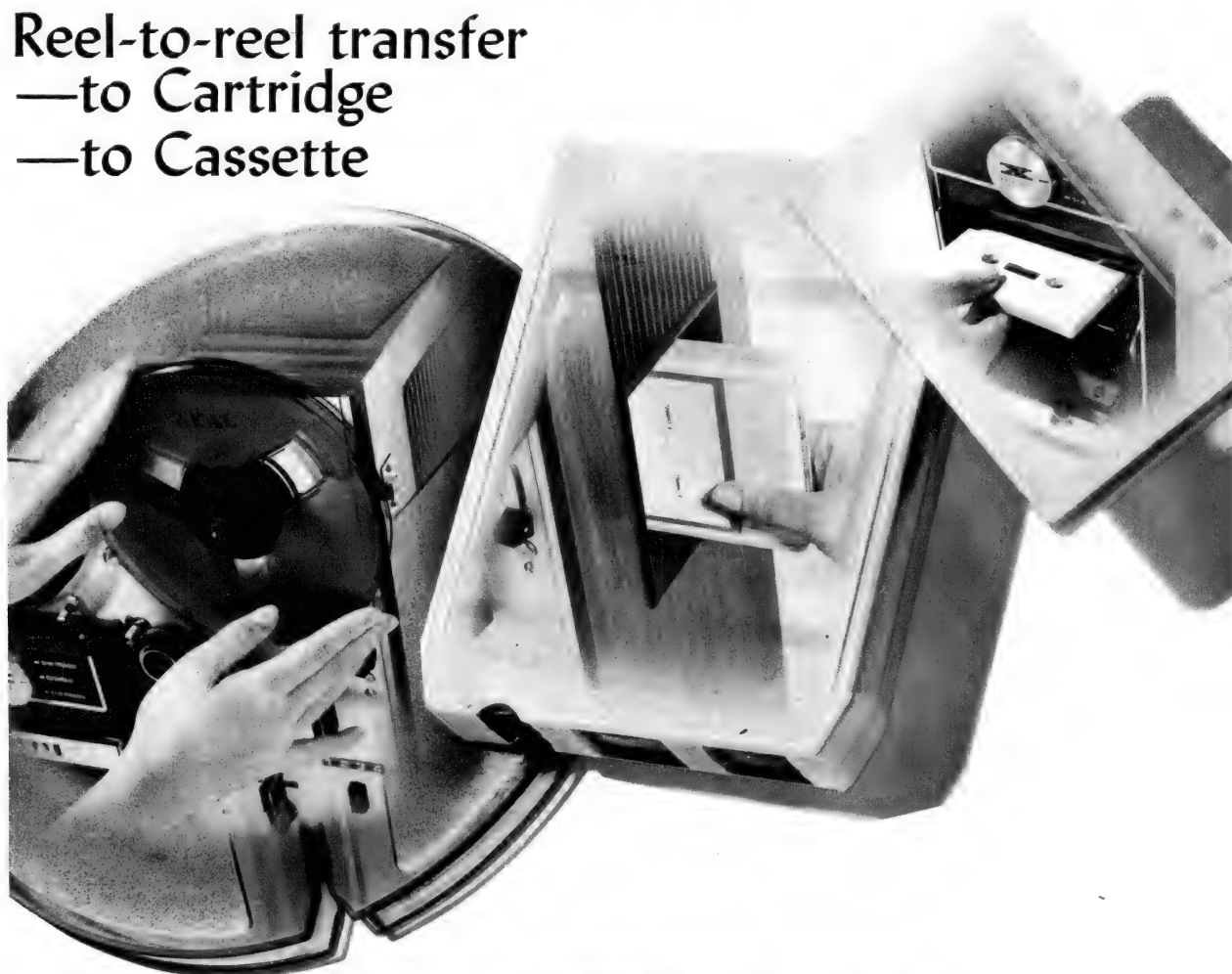
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porting role for the instrumentals, with her partner. This has tended to have a significant effect on the group's style, and I am not at all sure that this change is for the better. Buyers of this record will be able to make their own decision in the matter, as in more than half the tracks the earlier technique is maintained. Track titles are: Wichita Linesman — Norwegian Wood — Some Time Ago — Moanin' — Look Who's Mine — Ye-Me-Le — Easy To Be Hard — Where Are You Coming From? — Masquerade — What the World Needs Now. (H.A.T.).

★ ★ ★

AMOR MEXICO/S.A. Tony Mottola, guitar, with orchestra. Stateside (E.M.I.) stereo SOSL-10060.

Interest: Spanish/L.A. tunes.
Performance: Mellow, relaxed.
Quality: Excellent.
Stereo: Good spread.

This is a re-issue on the Stateside label of one of the excellent Enoch Light/Command discs of a few years ago. In fact, this disc is dated by the "Tijuana Taxi" track, with its frank imitation of the Tijuana Brass style — I think it is correct to assume that it appeared when the Herb Alpert group was at the peak of its popularity. Also in the selection are: La Raspa — Quando Vuelva a Tu Lado — Vaya Con Dios — Peligro Bossa Nova — Baile de Venezuela — Baia — Cavquinho — Cuando Caliente el Sol — La Mentira — Recado Bossa Nova — Yo Te Amo.

Splendid support from Mottola's lyrical guitar playing is provided by artists of the calibre of Doc Severinsen, trumpet; Dom Cortese, accordion; Phil Kraus, marimba; Al Casamenti, rhythm guitar; Bob Haggart, bass; and Bobby Rosengarten, drums. With such a line-up of talent, the results can hardly fail to be entirely satisfying. The tunes are good, the arrangements are first class and sound quality is excellent. What more can you ask? (H.A.T.).

★ ★ ★

MIDNIGHT COWBOY. Ferrante and Teicher, with orchestra and chorus conducted by Nick Perito. United Artists (Festival) stereo SUAL-933,604. Available in mono.

Interest: Piano duo.
Performance: Slickly commercial.
Quality: Excellent.
Stereo: Normal.

There are no gimmicks about piano duettists Ferrante and Teicher. The material they play is either firmly established current hits or popular evergreens; their arrangements are straightforward no-nonsense affairs; the supporting artists are good studio musicians, whose function is to provide soft harmonies behind the twin pianos, and carry the melody when the pianos are silent; and their piano work is slick, smooth and uncomplicated. All this may not sound very enterprising, but it has apparently paid off, judging by the regularity of their releases. If you like their style, this newest release is as good as any of their earlier efforts I have heard. Included are: Midnight Cowboy — Little Green Apples — Aquarius — Scarborough Fair — Popi — Love's Old Sweet Song — Gentle On My Mind — The Windmills of Your Mind — Those Were the Days

— The Sound of Silence — My Way — Rock-A-Bye-Baby. The technical side of the disc is of excellent standard. (H.A.T.).

★ ★ ★

A TAVERN IN THE TOWN. The Honky Tonk Piano of Bobby Allen, Compatible stereo, Music For Pleasure MFP-A8098.

Interest: Old timers.
Performance: Mainly strict tempo.
Quality: Good.
Stereo: Adequate.

If you're greying around the temples, you'll almost certainly enjoy this line-up of oldies: South Of The Border — Nellie Dean — There's A Tavern In The Town — Galway Bay — Ain't She Sweet — Walking My Baby Back Home — On Mother Kelly's Doorstep — The White Cliffs Of Dover — When The Red, Red Robin — It's A Sin To Tell A Lie — Annie Laurie — Now Is The Hour.

So much for the numbers. How much you actually enjoy them will depend on your reaction to the honky-tonk piano. If you like it, you'll enjoy Bobby Allen's performance; if you aren't too keen on the mistuned strings, the slower numbers will give you more than the usual time to contemplate the twang!

But, once again, if the music appeals, the MFP price and 35-plus minutes of playing time make this good value. (W.N.W.)

★ ★ ★

THE GOLDEN AGE OF SONG. Various artists, His Master's Voice (E.M.I.) mono OXLP 7524.

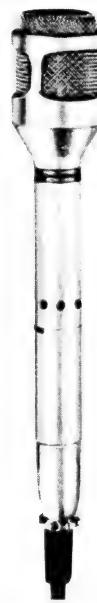
Interest: Tuneful arias and songs.
Performance: The best.
Quality: Well remastered.

Do you remember, before the LP era, that if you wanted Saint-Saens' "Softly Awakes My Heart" you did not have to wonder which of dozens of versions you should choose? — Marian Anderson's version was the automatic choice from the few available. Or "A Bachelor Gay" from "Maid of the Mountains"?; Peter Dawson, of course. Then there was "The Holy City," and you did not have to look beyond the Richard Crook recording. These and others of the same category, the standards of their time, make up the ten tracks of this enjoyable disc. The others are: E Lucevan le Stelle from "Tosca" (sung by Giuseppe de Stefano); Letter Scene and Waltz from "Der Rosenkavalier" (Alexander Kipnis and Elise Ruziczka); Gendarmes Duet from Offenbach's "Genevieve de Brabant" (Malcolm McEachern and Harold Williams); Funiculi-Funicula (Miliza Korjus); Santa Lucia (Luigi Infantino); Wer Uns Getraut from "The Gipsy Baron" (Herbert Ernst Groh and Emmy Bettendorf); Glück Das Mir Verlieb, from Korngold's "The Dead City."

A delightful selection of tunes, wonderfully sung in every track. In fact, I should say that here there is virtual perfection in every sense except one — the sound quality of the old 78rpm discs from which the tracks are taken. Yet even this is surprisingly good, since the tracks have been expertly remastered, and there is virtually no residual surface noise. If you can answer the first question posed above in the affirmative, you will find much to delight you in this disc. The price, by the way, is only \$3.65. (H.A.T.)

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THE FOOL ON THE HILL — George Shearing. Capitol (EMI) Stereo ST 181.

Interest: Mainly quartet.
Performance: Pleasant.
Quality: Flat recording.
Stereo: Well balanced.

It is many years since English-born pianist, George Shearing, made a jazz album but it should be said that, in his day, few pianists could match his superb playing. It is inevitable, but none the less regrettable, that Shearing should feel obliged to concentrate on mood-music albums.

This most recent Shearing LP provides easy and relaxed listening, however. All eleven tracks are Latin-flavoured and in some, Shearing augments his quartet and quintet with Latin/American percussion.

Most of the songs are familiar and include Cole Porter's "Easy To Love" and "I Concentrate On You," Lennon/McCartney's "Fool On The Hill" and Burt Bacharach's "Promises," one Shearing original called "Simple Side-man," and three Jobim compositions, "Wave," "Meditation" and "Favela."

The music on this album, therefore, lacks substance but it is polished, pleasant and well played — ideal, in short, for late-night listening. But the playing-time of 29 minutes is grossly inadequate. (T.F.C.)

★ ★ ★

THE BEST OF THE KINGSTON TRIO. Capitol (E.M.I.) stereo SENC 9566. (Price \$2.50)

Interest: Folk group.
Performance: Good entertainment.
Quality: Good standard.
Stereo: Normal.

Despite their retirement from active recording several years ago, the Kingston Trio have remained popular. This \$2.50 disc, which claims to be their best tracks, should therefore entice a lot of folk music enthusiasts. One might have other ideas about which tracks should be included under this title, but what the heck... somebody thought these were the group's best tracks, so they should have something. Certainly "Tom Dooley" which starts side one, and their version of "Where Have All the Flowers Gone" on side 2 were received with rapture whenever they performed live. Also included are: The Tijuana Jail — Scotch and Soda — Bad Man's Blunder — Raspberries, Strawberries — Everglades — M.T.A. — The Merry Minuet — Billy Goat Hill — Take Her Out of Pity — A Worried Man. I personally would not have included some of these in my selection for the group's best tracks, but still I found this a very enjoyable recording by three fine artists. (H.A.T.)

★ ★ ★

AN EVENING AT THE COSTA BRAVA. Various artists. Decca (E.M.I.) stereo SKLA 7659.

Interest: Popular Spanish numbers.
Quality: Excellent.
Stereo: Normal.

The Costa Brava is a popular Spanish holiday resort on the Mediterranean sea, but this is not the Costa Brava meant here. I assume the locale is a German night spot which features Spanish-style entertainment, since the recording was made in Germany, and the orchestra has the unlikely name of "Das Orchester Charles Parker." While one might be inclined to suspect the Spanish origins of the orchestra, the



This Snow White chick . . . was she one of the Seven Dwarfs group? ("TV Times").

artists who appear with it do not come into question. There is a pair of guitar-strumming male vocalists called Los Verde Luna (The Green Moons) who provide very pleasant sounding versions of "Cucurucucu" and "Mexico"; a guitar virtuoso called Eddie Pequenino who contributes sparkling accounts of "Mambo Boracho," "Las Muchachas" and "El Toro y la Luna"; a delightful female vocalist called Luisa Linares with a backing group called Los Galindos who contribute "Linda es Mi Tierra" and "Rosita Donde Estas."

The orchestra itself provides splendidly vigorous versions of the following Spanish bullring standards: Espana Cani — La Cumparsita — Spanish Eyes — El Gato Montes — Mexican Hat Dance. I thoroughly enjoyed listening to this record, and I recommend it to those who have a liking for Spanish-style music. The recording is of excellent quality. (H.A.T.)

HURT SO BAD — Nancy Wilson. EMI (Capitol) Stereo ST353.

Interest: Magnificent artist.
Performance: Very good.
Quality: Well recorded.
Stereo: Even spread.

When I reviewed Nancy Wilson's last album (Son of a Preacher Man — ST234) in these pages, I commented that she is "one of the most talented of the contemporary popular singers."

This new LP more than sustains her superb reputation. Like Sinatra, Bennett, Cole and a few others, she has the ability to make a song her own with her velvet-smooth voice, superb phrasing and intelligent feel for lyrics.

The material on this LP, however, is a shade disappointing with very few songs of outstanding merit. The tracks include, however, excellent performances of the recent chart success, "Spinning Wheel," Paul Webster's "Ages Ago," Alan Lerner's "Come Back To Me" and the beautiful Burke/Van Heusen song, "Do You Know Why."

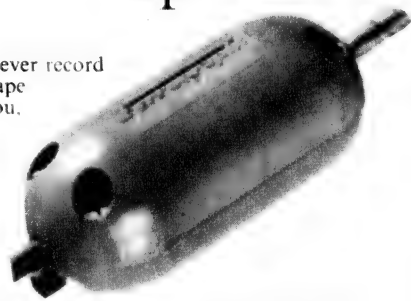
As with most Nancy Wilson albums, the charts are immaculate and the quality of the musicianship very high. The arrangers include Phil Wright, Oliver Nelson, Jimmy Jones, Billy May and Sid Feller.

Despite the poor playing-time of 27 minutes (why is Capitol so disappointing in this regard?), this album will delight Nancy Wilson admirers, although they, too, would probably concede that she has made rather superior LPs in the past. (T.F.C.)

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TODAY I SING THE BLUES —
Aretha Franklin. C.B.S. Stereo
SBP 233773.

Interest: Blues and Gospel.

Performance: Disappointing.

Quality: Poorly recorded.

Stereo: Normal separation.

For the past two years or so, both Festival and C.B.S. have been releasing Aretha Franklin albums in Australia. The Festival issues derive from her current Atlantic contract and, to this extent, the continuing release of the older Columbia recordings is misleading.

Judging from this latest C.B.S. album — which contains only 10 tracks and plays for a meagre 27 minutes — the Columbia well is fast running dry. In addition, these tracks are relatively poor-quality Aretha Franklin and will not enhance her reputation as one of the most exciting artists in the world today.

The most successful tracks on the album are Aretha's own "Without the One You Love," "Rough Lover," "Evil Gal Blues," "Every Little Bit Hurts" and the title track.

On paper, the backing looks strong with names like Jerome Richardson, Joe Newman, Frank Wess and Benny Powell but the arrangements and production are respectively dull and slack. Only the most devoted Aretha Franklin collector would find lasting value in this album. (T.F.C.)

★ ★ ★

FRANCOISE HARDY IN ENGLISH.
Vogue Records (Festival) stereo
SVL-933,391. Available in mono.

Interest: French singing star.

Performance: Pleasing style.

Quality: Excellent.

Stereo: Normal.

To the string of very successful Vogue discs released by Festival featuring the enchanting Francoise Hardy can now be added this latest one, which has the added advantage, for most people anyhow, that it is all sung in English. Most, if not all, of these numbers have already appeared in their French versions in the previous releases. If you have those, you will have to make your own decision as to whether you want both versions. You will probably be as charmed by M'selle Hardy's French accent as I was, but not surprisingly her singing loses something of the relaxed atmosphere which characterises her normal singing in her native language. The orchestral support and sound quality are entirely satisfactory.

To enable prospective purchasers to check against discs they already hold, I am giving both the English and French titles: This Little Heart (Ce petit Coeur) — All Over the World (Le Monde Entier) — However Much (Et Meme) — It's Getting Late (Il Se Fait Tard) — Only Friends (Ton Meilleur Ami) — Say It Now (Dis-lui Non) — Just Call And I'll Be There (Le Temp de Souvenirs) — The Rose (Mon Ami la Rose) — Only You Can Do It (Je Veux qu'il Revienne) — It's My Heart (Tu Peux Bien) — Another Place (La Nuit est Sur la Ville) — Autumn Rendezvous (Rendez-vous d'automne). (H.A.T.)

SONGS FOR SWINGING SELLERS.

Peter Sellers and Irene Handl. Parlophone (E.M.I.) stereo SPME0 9544 (\$2.50).

Interest: British comedian.

Performance: Keenly satirical.

Quality: Good.

Stereo: Useful in places.

Sellers fans will be aware that he is no vocalist, and will be relieved to find that in this disc we are mercifully spared a demonstration of his singing ability for most of the time. The tracks are actually a series of satirical sketches, the main target of which is pretentiousness in all its forms. For example, the ancient singing fondly of "My Dear Old Dutch" (this being the only vocal effort by Sellers) heaps abuse on the poor old dear who is the object of his affection when she interrupts his song. The English upper class nobleman discusses his tenants as though they are so much livestock, in another track. One gem concerns the television interviewer who mercilessly assails the character of the interviewee, without letting him get a word in for his own defence. Even the sleeve note pokes fun at the solemnly worded nonsense commonly found in "Instructions for Use" notations.

Sellers is aided and abetted in his attacks by English comedienne Irene

Handl, and as this is the only other credit given in the sleeve note (except in one instance) we must assume that the rest of the many voices heard are supplied by Sellers himself. He is certainly versatile enough to do this.

You will find plenty to raise a laugh in this disc, if your sense of humour is attuned to this kind of wit. Presumably the tracks have their origin in radio and television programs, but this information is not volunteered in the sleeve note. The sound quality is adequate. (H.A.T.)

★ ★ ★

THE BEST OF PETULA CLARK.

Astor Stereo SPLP 1292 (mono compatible).

Interest: Popular English singer.

Performance: Strong selection.

Quality: Well recorded.

Stereo: Adds little.

Petula Clark's recent recordings have not repeated her huge successes of a year or two ago. But she is still one of the most consistent and talented singers in the business.

This "Best of" album has been sensibly compiled with hit singles like "Colour My World," "Don't Sleep in the Subway," "I Want To Sing With Your Band," "The Other Man's Grass" and "This is My Song."

"Extraordinary Value"

THE GREAT FRANK SINATRA. Music For Pleasure MFP-A8100-1. Mono.

Interest: 26 recordings, 1953-1961.

Performance: Generally excellent.

Quality: Acceptable.

This 2-LP set, released by Music For Pleasure at the bargain price of \$3.95, contains some of Sinatra's finest recordings for the Capitol label. The tracks span the six years or so between December 1953 and March 1961.

During these years Sinatra was in magnificent voice, full of confidence and feeling and able to do full justice to a slow sentimental ballad and to a rip-roaring up-tempo song.

Some of the highlights on these two LPs include "I'll Be Around" (1955), "Moonlight In Vermont" (1957), "That Old Feeling" (1960), "Here's That Rainy Day" (1959), "That Old Black Magic" (1961), "Just One Of Those Things" (1954), "The Lady is a Tramp" (1956) and "I Concentrate on You" (1960).

As long established Sinatra collectors will recognise, these tracks come from a number of Sinatra Capitol LPs and duplication could well be a problem for many readers. But for someone with relatively few Sinatra albums, this 2-LP set represents quite extraordinary value. There is not a poor track among them and most of them rate with Sinatra's greatest work.

Unfortunately there are no recording details on the sleeve and, in addition, Nelson Riddle is credited with all the arrangement. In fact, Billy May was responsible for quite a few of the charts. Nevertheless, with the proviso mentioned above, this is one of the bargains of recent years. (T.F.C.)

THE GREAT NAT KING COLE. Music For Pleasure MFP-A8102/3. Mono.

Interest: Early Nat King Cole.

Performance: Generally first-class.

Quality: Acceptable.

Like the Frank Sinatra 2-LP set on Music For Pleasure, this represents quite extraordinary value. The first two sides were recorded by the Nat King Cole Trio in the years 1943 to 1949. During these years his Trio included outstanding musicians like Oscar Moore, Johnny Miller, Irving Ashby and Jack Costanzo.

But a large part of the charm of these Trio recordings comes from Cole's excellent piano. Jazz enthusiasts, of course, regret very much his abandonment of piano playing since the early fifties, for his instrumental work was delicate, swinging and very much in the Hines/Tatum/Wilson tradition.

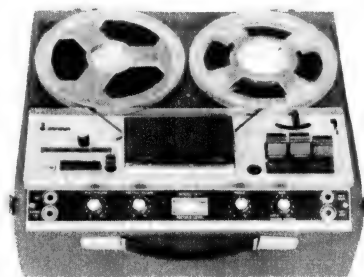
The Trio tracks feature Cole's singing and playing on "Sweet Lorraine," "For All We Know," "Embraceable You," "Little Girl," "Making Whoopee" and seven more.

The 12 tracks on the second LP in this set include some of Nat Cole's big successes of the early fifties after he had forsaken the intimacy of the Trio for the more commercial lushness of Nelson Riddle's Orchestra. Most of the songs are first-rate including "Somewhere Along The Way," "Faith Can Move Mountains," "Because You're Mine," "A Weaver of Dreams" and "If I Give My Heart To You."

Duplication may again be a problem for many readers, but this 2-LP set would serve as an excellent introduction to Nat King Cole's early recordings of the late forties and early fifties. (T.F.C.)

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It is no coincidence that seven of the twelve tracks were written by Jackie Trent and Tony Hatch, for Miss Clark's most successful recordings were with compositions by this very talented husband-and-wife team. Most of the arrangements too, were written by Tony Hatch.

The 35 minutes of music on this album represent good value for admirers of Petula Clark. (T.F.C.)

★ ★ ★

THE BEST OF BILL COSBY. Stereo, Warner Bros., WS-1798.

Interest: More Cosby humour.

Performance: Usual Cosby style.

Quality: Good.

Stereo: Not important.

Like old Father Thames, Bill Cosby keeps rolling along, wowing them in the clubs, turning out more albums and producing new scripts — if, in fact, he

can ever be thought of as working from a script.

This new album is entitled "The Best Of Bill Cosby" and, as might be expected, at least some of the tracks are repeated from other albums. Three tracks involving the story of Noah don't follow "The Book" at all closely. The same remark applies to "The Apple," with Adam and Eve as the main characters. Other tracks include: Revenge — The Lone Ranger — Old Weird Harold — Driving in San Francisco — Babies — The Water Bottle — Street Football — Fat Albert.

If you're a Cosby fan, this album will rate with the rest. If you want a Cosby record for that odd spot in your record sessions, I personally would suggest one of his earlier records which were a little more spontaneous, more truly reminiscent of Cosby junior. (W.N.W.)

Popular Jazz

KNOCKED-OUT NOCTURNE. Ralph Sutton. Festival (Project 3.) Stereo SPJL 933523.

Interest: Piano trio.

Performance: Excellent.

Quality: Superbly recorded.

Stereo: Good balance.

This LP by the rather neglected pianist Ralph Sutton is a most welcome addition to the local jazz catalogues.

Sutton first came to prominence during the war when he played with Jack Teagarden and his growing reputation was consolidated during his long residency at Eddie Condon's Club in the late 1940s and early 1950s.

Sutton is one of the most accomplished of the post-war stride pianists with a masterful technique and creative ideas. The influence of Fats Waller, Art Tatum, James P. Johnson, Jess Stacey and Joe Sullivan is very obvious throughout the 12 tracks on this LP.

On most of them Sutton plays trio piano with the excellent backing of Bob Haggart (bass) and Gus Johnson (drums). On four tracks — "Honey-suckle Rose" "Hobson Street Blues" "Eye Opener" and "I Got Rhythm" — the trumpet of Yank Lawson and the soprano of Bob Wilber add some background colour to the sound and the latter contributes an elegant solo on the ballad "Love Lies."

The pick of the trio tracks include Beiderbecke's "In A Mist" and "In The Dark" and Waller's "Alligator Crawl" and "Viper's Drag."

The 37½ minutes of piano on this album will be a joy for all admirers of Ralph Sutton's tasteful swinging and inventive piano playing. Recommended. (T.F.C.)

★ ★ ★

COUNT DOWN — Charlie Munro. EMI (Columbia) Stereo SCXO 7911.

Interest: Australian modern jazz.

Performance: Adventurous.

Quality: Well recorded.

Stereo: Normal separation.

This album by Sydney musician Charlie Munro — the first local modern jazz LP for several months —

was produced by EMI in association with the Australian Performing Rights Music Foundation.

The 51½ minutes of music is, at its best, adventurous, uncompromising and stimulating. Side one, "Count Down," was conceived as the music for a contemporary ballet, with five major soloists featured against a predominantly string orchestra. The soloists are Munro on reeds and flutes, Graeme Lyall on tenor, Bob McIvor on trombone, Mark Bowden on percussion and vibes and Bruce Cale on bass.

The ensemble passages seemed to me to be a little on the soft side and the score to lack structure and genuine direction. But the solos are the essence of the performance and, in this regard, the results are outstanding with all five musicians — particularly Lyall and Cale — improvising in a thoughtful and meaningful way.

The second side of the album contains two fully improvised pieces — "Whirlpool" and "The Scene" — with only the trio of Charlie Munro, Mark Bowden and bassist Neville Whitehead. Once again the solos are often imaginative and constructive but my overall impression was that the music was rather artificially free and deliberately contemporary.

I would not wish to give the impression that this LP is a failure, for it is very far from that — particularly on the grounds of the splendid solos. But somehow the music is not completely satisfactory; it lacks an authority and conviction which would have made it a great album.

By the same token, I am very sure that repeated playings over a period of months will prove to be rewarding. This Australian LP should at least be heard by all readers who profess an interest in contemporary jazz. (T.F.C.)

★ ★ ★

FLAMING YOUTH — Duke Ellington. RCA Vintage Series LPV 568.

Interest: 1927-29.

Performance: Magnificent tracks.

Quality: Very well remastered.

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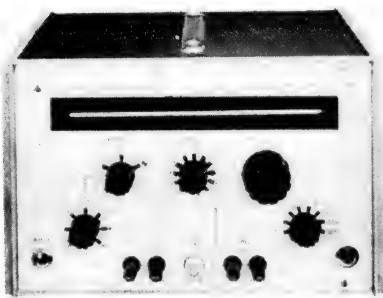
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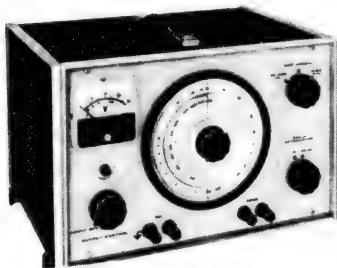
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SG67A. A portable wide range oscillator providing sine or square wave output over freq. range 1Hz to 1MHz.

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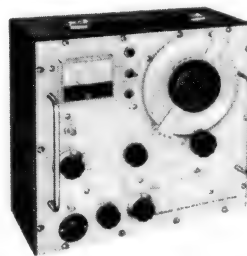
SG68. Provides an exceptionally low distortion sine wave output. Distortion is no greater than 0.01% over the range 20Hz to 20kHz. A square wave output with rise and fall times of less than 100ns is provided, and a max. output of 4V is available on both sine and square waves. A four-range push-button attenuator and calibrated fine adjustment controls output level.

5

SG70. A high power LF unit with a sine wave output of 4W into 600Ω, 49V RMS or 4W into 5Ω over the freq. range 5Hz to 125kHz. Voltage level is adjusted by a seven-position attenuator (+ 30dB to - 20dB) and a cont. variable fine control.

6

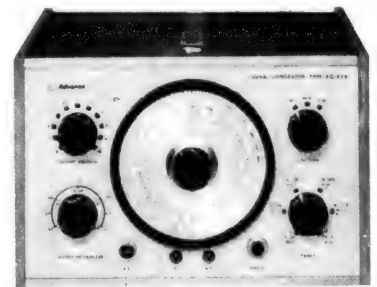
(3) RF



B4A7, B4B7 (above). Primarily intended as a lab. instrument and is available with alternative freq. ranges covering either 100kHz to 80MHz (B4A7) or 30kHz to 30MHz (B4B7). Cont. adjustment of RF output level is provided between 1μV and

100mV by a non-inductively wound potentiometer and step attenuator. The level can be accurately set by use of a crystal voltmeter which monitors the level into the step attenuator. Output signal can be modulated internally by 400Hz to a depth between 0 and 80% or by an external modulating source.

7



SG62B. Produces RF signals over the wide freq. range 150kHz to 220MHz. A band spreading device ensures an open scale at the high frequency end of each band. The output signal may be either a continuous sine wave or may be modulated 30% at 400Hz. A truly portable instrument complete with case and carrying handle.

8

E2. Operates entirely on fundamental freq. in the range 100kHz to 100MHz. It is characterised by exceptionally low RF leakage which, even at 100MHz, is less than 3μV. Attenuator system embodies a non-inductive slide-wire followed by a five-decade ladder network. The directly calibrated illuminated scale has a total length of over 30 in. Setting accuracy is assured by the inclusion of a 10:1 ratio slow motion drive.

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recent Australian Tour by the Orchestra — the other two being "Far East Suite" and "His Mother Called Him Bill."

Let me make it clear at once that this important reissue is essential listening for every collector with the slightest interest in Duke Ellington's music.

The sixteen tracks were recorded between October, 1927, and January, 1929, a period when the unique personality and character of the Ellington Orchestra were beginning to develop and emerge. At the same time the band was still dominated by its great individual soloists — particularly Bubber Miley and Joe Nanton — and in the context of the Cotton Club the band's sound was the "jungle" style.

This is a fascinating period in Ellington's musical development with the increase in the size — and textural potential — of the band the advent of new soloists like Hodges, Carney and Bigard and the increasing maturity and expertise of Ellington as a composer and arranger.

Ten of the sixteen tracks were composed by Ellington and four by Jimmy McHugh and Dorothy Fields but the latter are comparatively lightweight cabaret features. The outstanding tracks include classics like "Black and Tan Fantasie," "Jubilee Stomp," "Flaming Youth," "The Mooche," "Creole Love Call," "East St. Louis" and "Black Beauty" — all superb examples of vintage Ellington. Adelaide Hall sings on "Creole" and "Blues I Love To Sing," and, aside from Miley and Nanton, major soloists are Otto Hardwicke and Harry Carney (both musicians on alto and baritone), Artie Whetsol and Rudy Jackson.

Three tracks incidentally — "Blues I Love To Sing," "Washington Wobble" and Victoria Spivey's "No Papa No" — are previously unissued performances. The LP plays for a full 50 minutes: and the price is only \$3.95.

This album is highly recommended to all collectors. (T.F.C.)

★ ★ ★

GREATEST HITS — Thelonius Monk.

CBS Stereo SBP 233693.

Interest: 1960s material.

Performance: Useful collection.

Quality: Mainly good.

Stereo: Well balanced.

The suggestion in the album title that Thelonius Monk has recorded "hits" seems a somewhat extravagant term of phrase. The LP, in fact, includes nine of Monk's better-known compositions, which he has recorded for Columbia during the past seven or eight years.

Unfortunately, Monk's Columbia recording sessions have, with exceptions, been rather on the dull side and a compilation of his "best" work would have to include a majority of tracks which he recorded earlier for the Prestige and Riverside labels. Nevertheless, this album is probably a useful enough introduction to the jagged, stark but rewarding world of Monk.

Most of the tracks are by the quartet with Charlie Rouse on tenor, either Larry Gales or Butch Warren on bass, and Ben Riley or Frankie Dunlop on drums. The quartet recordings include

Well, You Needn't — Misterioso — Bemsha Swing — Straight, No Chaser. Happily, the superb piano solos "Round Midnight" and "Ruby My Dear" are included and, in many ways, they are the most satisfying tracks on the album, with Monk at peak inspiration.

The late Pee Wee Russell joins the quartet on "Blue Monk" but this Newport Festival experiment was somewhat disastrous. The LP is completed by "Epistrophy," featuring Monk's ten-piece recording band but this track is too short for anything of substance to develop.

Mainly with newcomers to Monk's music in mind, this album can be recommended, particularly in view of the generous playing-time of 46 minutes. (T.F.C.)

★ ★ ★

FAR EAST SUITE — Duke Ellington and his Orchestra. Victor stereo LSP 3782.

Interest: Ellington 1966.

Performance: Outstanding.

Quality: Excellent recording.

Stereo: Good separation.

This is one of the three Ellington LPs which were released in Australia to coincide with his recent tour here. Nevertheless RCA should be roundly condemned for not releasing this superb LP earlier. It was, after all, recorded in December, 1966 and, cynically, one can well believe that it would never have been released in Australia had it not been for the tour.

Had it not been for "And His Mother Called Him Bill," this would undoubtedly have been the Ellington LP of the decade. The nine impressionistic sketches were composed between late 1963 and 1966 following Ellington's 1963 State Department Tour of the East and his 1964 visit to Japan. Clearly Ellington was influenced by the things he saw and heard on these tours but the music still remains pure Ellington/Strayhorn.

The Ellington band in 1966 was considerably superior to the one we saw here, principally because of the presence of Jimmy Hamilton, Paul Goncalves, Lawrence Brown and Buster Kooper. These, and the other great soloists in the band, are well featured on the Eastern tone poems which comprise this LP.

The outstanding tracks are "Blue Pepper," "Isfahan" (both featuring Johnny Hodges), "Agra" (with Harry Carney), "Amad" (Lawrence Brown) and "Ad Lib on Nippon" which demonstrates the virtuosity of John Lamb on bass and Jimmy Hamilton on clarinet.

But once again, this Ellington album should be absorbed in toto, for the breathtaking textures in the orchestrations, the haunting, probing themes and the outstanding solo work by Ellington himself and his sidemen.

As in the case of "Bill," this album comes with the highest recommendation — not in terms of an LP that is simply good today, but in terms of a musical achievement that will stand the test of decades. (T.F.C.)

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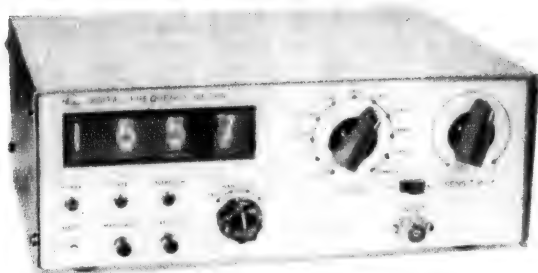
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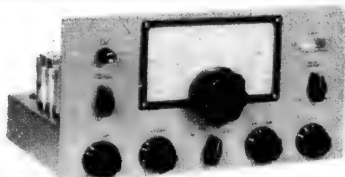
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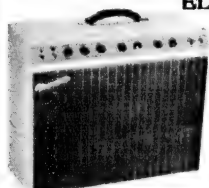
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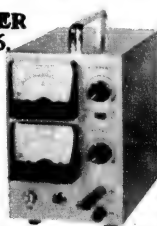


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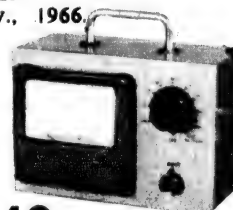


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TRADE REVIEWS AND RELEASES

LUX SQ77T amplifier is good value

In the August 1969 issue of "Electronics Australia" we reviewed the LUX SQ1220 amplifier and found it to be very well finished and good value for money. Here we review the LUX SQ77T, a somewhat less expensive model, and find that it is also a good buy. It was submitted for review by International Dynamics (Agencies) Pty. Ltd., sole Australian agents for LUX equipment.

The overall dimensions of the amplifier are 14½ in x 5½ x 8 in deep. A wooden case is fitted and is included in the basic price. The front panel is of gold-anodised aluminium with a fine brushed finish. The turned aluminium knobs are finished and have a milled "flat" to give purchase and serve as a setting indicator. All the knobs rotate with a silky smoothness and the rocker switches have a positive snap-action.

Knobs are provided for the selector and mode switches, along with volume and balance controls and the separate bass and treble controls for each channel. Rocker switches are provided for power, tape monitor, scratch filter, rumble filter and loudspeaker/phone selector.

Phono sockets are provided on the rear panel for inputs for magnetic cartridge, tape, tape monitor, and two other auxiliary signal sources such as radio and TV. A 5-pin DIN socket is also provided for connection to a tape recorder. Loudspeaker outlets take the form of polarised sockets which take female plugs. These greatly reduce the possibility of short circuits and simplify the task of loudspeaker phasing. An unswitched 2-pin AC outlet is provided for connection of turntable or other low power appliance.

Removing the wooden cabinet of the amplifier reveals neat workmanship, easily serviced layout and good quality components throughout. The rear panel is ventilated to allow cooling of the vertically mounted heatsinks, which are quite small. The designers have evidently taken full advantage of the higher operating temperatures possible with silicon transistors. The majority of the circuitry is accommodated on four plug-in printed boards which are mounted toward one end of the chassis while the transformer is mounted at the other end.

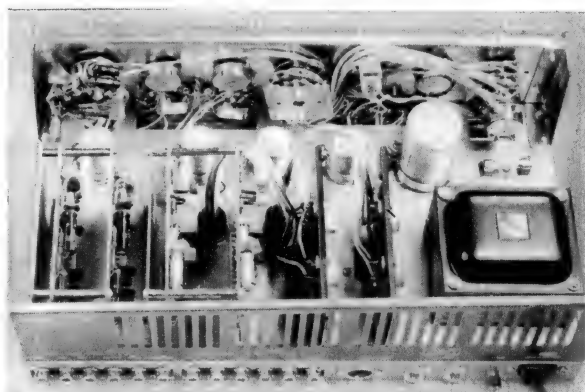
One feature of the assembly we did not like was the mounting of the two fuseholders. These are mounted on the chassis so the amplifier must be removed from its case to replace fuses. The method of mounting is such that the fuseholder solder lugs are in very close proximity to the metal chassis — this is especially hazardous in the case of the mains fuse. Attention to this detail would be a worthwhile improvement.

The complete circuit of the amplifier contains 20 transistors in all, most of the circuit being fairly conventional. The input stage consists of two transistors connected in a direct-coupled feedback arrangement and these provide equalisation and a degree of amplification for signals from magnetic cartridge, tape head (at one speed) and high level signals.

Following the input stage is the tone control stage consisting of two transistors



At right is a view of the amplifier with the wooden case removed. The layout is clean and uncluttered.



in a conventional negative feedback configuration. At the input to this stage are the "scratch" and "rumble" filter components which give a modest rolloff at 5KHz and 80Hz, respectively. The scratch filter is not sharp enough to be effective against bad noise and similarly, the rumble filter is not sharp enough to enable turntables with a lot of inherent rumble to be used satisfactorily.

The volume control for each channel consists of a pair of ganged potentiometers, one operating at the input of the tone control stage and the other at the output of the same stage. This ganged pair is ganged with the potentiometers for the other channel. This arrangement has apparently been adopted, as in the Lux SQ1220 referred to above, to maintain an optimum signal-to-noise ratio over the whole control range. It would also have the effect of providing the tone control stage with excellent overload capability.

The power amplifier stage is very similar to that used in the Lux SQ1220 amplifier and consists of six transistors in a direct-coupled feedback amplifier with the output transistors connected in a conventional quasi-complementary configuration.

The rated power output of the amplifier is 60 watts RMS (30 watts per channel) into 8-ohm loads and 40 watts RMS (20 watts per channel) into 16-ohm loads. Total harmonic distortion was rated at less than 0.5 per cent at 20 watts into 16 ohms at 1KHz.

We measured power output at 23 watts per channel into an 8-ohm load at the onset of clipping and 28 watts with one channel driven. THD at 1KHz at 23 watts per channel was 0.4 per cent and 0.3 per cent at 28 watts with one channel driven.

Power output into 16-ohm loads was 15 watts per channel and 17 watts with one channel driven. Distortion at 1KHz was 0.3 per cent at 15 watts per channel and 0.2 per cent at 17 watts into one channel. The figures for power output are a little down on those claimed but this would not be apparent in a domestic situation.

Frequency response at 1 watt and power bandwidth at 23 watts per channel were the same with minus 3dB points at 28Hz

and 50KHz, which is excellent. Separation between channels referred to 28 watts into 8-ohms was very good at minus 48dB over the range from 100Hz and 10KHz. This was measured with the non-driven channel input unloaded. All the above measurements were taken using the Auxiliary input which had an input sensitivity of 200mV RMS.

The tone controls gave a range of plus 8dB and minus 9dB at 10KHz and plus 11dB and minus 10dB at 100Hz, which is less than usual but adequate for most purposes. Square wave response was good over the whole range and stability with capacitive loads was excellent.

Sensitivity of the various inputs was found to be very close to the figures specified but the overload capability could be improved upon. The magnetic cartridge input could handle 30mV RMS at 1KHz before audible overload occurred. While this represents a factor of some 24dB it is

really not sufficient, as some medium output cartridges will deliver in excess of 30mV on peaks. The input sensitivity of 1.8mV RMS for full power could easily be reduced to improve the overload capability, while still maintaining adequate sensitivity. For best results with this amplifier, use a low output cartridge.

On actual listening tests the amplifier performed well. There was no switch-on transient in the loudspeakers when first turning the amplifier on and at all settings of the controls the amplifier was commendably quiet. Using a low output magnetic cartridge there was gain to spare and no lack of power.

To sum up, this amplifier offers good power capability at a reasonable price. With some small detail improvements it could be made even more attractive.

Retail price of the amplifier is \$169, including tax, and it is available from outlets in most states. Trade inquiries regarding availability of this and other products in the Lux range should be made to the Australian distributors, International Dynamics (Agencies) Pty. Ltd., 4 Duke Street, Abbotsford, Victoria. (L.D.S.)

INSTRUMENTS FROM AWA

Marconi Instruments Ltd., of the U.K., has announced a number of additions to its range of equipments distributed in this country through the Engineering Products Division of A.W.A.

Counter/Timer, TF 2411. Performs a wide range of functions including period and multi-period measurements, time interval, ratio and frequency measurements to 50MHz. Features: a choice of plug-in frequency standards; uses mainly ICs; FET input with 10mV sensitivity and 1M input impedance; seven digit readout with binary memory; optional BCD printer output; HF-cut filter to exclude electrical interference.

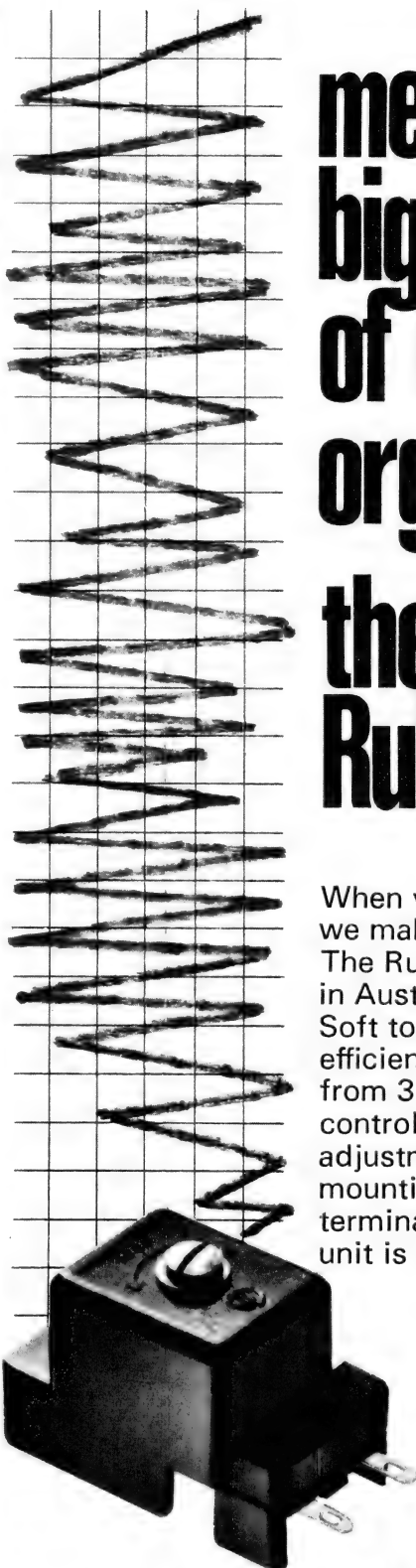
Counter/Timer, TF 2414A. Solid-state 6-digit single channel instrument. Features: 10mV sensitivity; direct frequency measurement to 40MHz; time interval measurement down to 1µs; period and multi-period measurement; 1M input impedance; display memory; stability and accuracy determined by oven-controlled crystal oscillator; standard frequency output available over range 0.1Hz to 1MHz.

Sweep Generator, TF2361. The basic unit, which is converted to video or VHF version by plug-in units, contains common power supplies and driving circuitry. Features: sweep speeds from .01Hz to 100Hz; frequency range 25KHz to 300MHz; automatic level control; frequency markers; each plug-in unit has calibrated sweep-width control; linear centre-frequency scale; can be locked to TV sync and blanking waveform.

Wide-Range Oscillator, TF 2103. Transistorised sine/squarewave portable oscillator continuously variable from 10Hz to 1MHz. Features: five range-selecting push-buttons; effective scale length exceeds 3ft; output signal amplitude continuously variable (in four switched ranges) from 0 to 2.5V; normally operates from two internal 9V batteries, but interchangeable mains power unit is available.

Power Supply, TF 2150. Bench-type miniature unit with continuous control of both current and voltage. Features: maximum output 25W; range 0-30V, 0-1.25A; regulation better than .05%; ripple less than 400µV; accuracy at 30V, 2pc; non-reentrant current protection; no range switching; can be operated as pulsed power source, linear DC power amplifier, etc. by changing terminal connections.

Further information on these and other instruments in the Marconi Instruments range is available from Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113.



meet the big noise of our organisation: the Rubin Buzzer

When you need to make a noise, we make it better than the rest. The Rubin Buzzer, made right here in Australia. Small size. Big noise. Soft tone. Compact (1" high) and efficient. 5 AC/DC Voltage Ranges from 3 v. to 60 v. Featuring tone control by means of simple screw adjustment. Single screw mounting. Solder/Quick connect terminals. Spark suppression unit is optional.

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73 Whiting Street, Artarmon, N.S.W. 2064. Telephone: 439 2333. Telex: 21175; 6 Kemp Street, Woodville, South Australia 5011. Telephone: 45 3579. Telex: 82529; 138 Berkeley Street, Carlton, Victoria 3035. Telephone: 34 6469. Telex 30948. Queensland — Telephone: 74 097; Western Australia — Telephone: 21 7861.

ESR5632



NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 \$18.00 Postage 50c

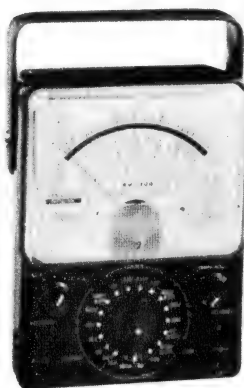


20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:
DC Volts. 0.5, 2.5, 10, 50,
250, 500, 1000 V
AC Volts. 10, 50, 250, 500,
1000 V
DC Current: 50uA, 5mA,
50 mA, 500 mA
Resistance: 5 kΩ, 50kΩ,
500kΩ, 5 MegΩ
Decibels. -10 + 62 lb
Accuracy. DC±3%, AC
±4% (of full scale)
Batteries. Two 1.5V dry cells.
Size AA, "Eveready" 915
● Overload-protected by dual
silicon diodes. ● Mirror scale.
● Double-jewelled ±2%
meter. ● ±1% temperature-
stabilized film resistors.

Model RH-100 \$39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC
● Overload Protected by Dual Silicon diodes ● Double-
jewelled ± 2 per cent Meter ● ±1 per cent Temper-
ature-stabilised Film Resistors ● Polarity Changeover
Switch ● Mirror scale, instruction for operation with
circuit diagram.



SPECIFICATIONS:
DC Volts: 0.6, 3, 12, 60, 300,
600, 1200V (100,000Ω/V)
AC Volts: 6, 30, 120, 300,
1200V (10,000 Ω/V)
DC Current: 12μA, 300 μA,
6mA, 60mA, 600mA,
12 amps DC and AC Cur-
rent 12 amps.
Resistance: 20KΩ, 200KΩ,
2MΩ, 20MΩ
Decibels: -20 to +17, 31, 43,
51, 63.
Accuracy: DC±3 per cent,
AC± 4 per cent (of full
scale)
Batteries: Two 1.5V dry cells,
size AA, "Eveready" 915

NEW TYPE Y-3 MULTIMETER



MEASURING RANGE:
D.C. Voltage: 6V, 30V,
150V, 600V (2000 ohms/
V). A.C. Voltage: 6V,
30V, 150V, 600V (2000
ohms/V). D.C. Current:
150 mA. Resistance: 0-
100,000 ohms. Complete
with 1.5 volt battery and
test leads. Size: 3 3/4" x
2 3/4" x 1 3/8".

Checked, Packed and
Posted — \$9.50.
Limited Stocks.

"HANDYMAN" RH 150 \$11.50



CHECKED
PACKED
& POSTED
FREE

Pocket-size 3 1/4" x 4 1/4" x 1 1/4".
Instruction sheet and circuit.
SPECIFICATIONS
DC Volts 2 1/2, 10, 50, 250, 1000.
AC Volts 10, 50, 250, 500, 1000.
DC Current, .1, 25, 250 M/amps.
Resistance, 20K and 2 megohms.
Decibels, -20db to +62db .7K/c.
Capacitance, .0001, .01, .0025, .25
mfd.

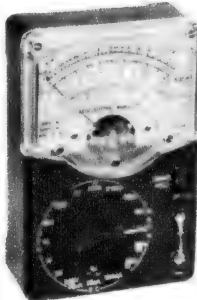
Model RH-20 \$15.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:
DC Volts: 0.25, 2.5, 10, 50,
250, 1000 (20,000/V)
AC Volts: 10, 50, 250, 500,
1000 (10,000/V)
DC Current. 50 uA, 25mA,
250mA
Resistance. 7kΩ, 700kΩ, 7MΩ
Decibels. -10 +22 (at AC/
10V) +20 +36 (at AC/
50V). Upper frequency limit
7kc.
Batteries: Two 1.5V dry cells.
Size AA, "Eveready" 915

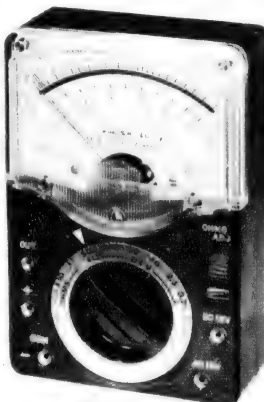
Model RH-55 \$20.00 Postage 50c



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:
*DC Volts: 0.6, 3V, 12V,
60V, 300V, 1200V (30,000
ohms/V).
*AC Volts: 12V, 60V, 300V,
1200V (14,000 ohms/V).
*DC Current: 60 A, 12mA,
300mA.
*Resistance: 10K ohm, 1Meg
ohm, 10Meg ohm.
*Decibels: -10 db +23 db.

Model RH-60 \$25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:
DC Volts: 0.25, 2.5, 10, 50,
250, 500, 1000 V
AC Volts. 10, 50, 250, 500,
1000 V
DC Current. 25 uA, 5 mA,
50 mA, 500 mA
Resistance: 10 kΩ, 100 kΩ,
1 MegΩ, 10 MegΩ
Decibels. -10 +62 db
Accuracy: DC±3%, AC±
4% (of full scale)
Batteries. Two 1.5 V dry cells.
Size AA, "Eveready" 915

Models RH-20, -55, -60 are:—

● Overload-protected by dual silicon diodes ● Mirror
scale ● Double-jewelled ±2% meter ● ±1%
temperature-stabilised film resistors.

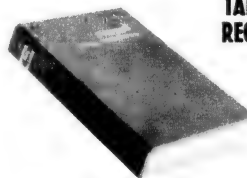
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clock, \$19.75.
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Six transistor pocket
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seven transistor
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TAPE RECORDER



\$20.50

BOOK TYPE

The latest model portable Tape-
recorder. 4 transistor, 3in reels,
2 tracks. Instruction manual. Size
10 1/2in x 7in x 1 1/2in.
Just open the book and record.
Supplied complete with tape, mi-
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anywhere.

RADIO HOUSE PTY. LTD.

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AKAI X-330 STEREO TAPE RECORDER

The Akai X-330 tape recorder is a machine offering a high degree of versatility. It has comprehensive reverse playing facilities and is equipped with its own power amplifiers for playback. It was submitted for review by the distributors, Akai Australia Pty. Ltd.

The X-330 is a 3-motor, 3-speed, 4-track stereo machine which is equipped with power amplifiers. It has comprehensive reversing facilities, using either metallic sensing tape or its own inbuilt timer. It can be used with reels up to 10½ inches in diameter and has the usual facilities incorporated in a multihead machine, i.e., sound-on-sound and echo. The unit is housed in an oiled teak case with matching lid.

At first sight, the number of controls on the deck is rather awe-inspiring and one almost wonders whether this effect was

smooth, quiet and spill-free due to the solenoid controls. The fast forward and reverse facility takes 75 seconds to rewind a 1,200 feet reel of tape. It is possible to go from fast forward to fast reverse without an intermediate stop without any problems of tape spillage or other malfunction. The tape transport is foolproof to the point that even disconnection of the mains supply will not cause tape spillage. The transport merely brakes to a smooth stop.

Very low figures are quoted for wow and flutter, as follows: Less than .04pc at

7ips; less than .07pc at 3ips and less than 0.15pc at 1-7/8ips. While we did not attempt to verify these figures, wow and flutter were noticeably absent at all speeds.

The unit can be set to turn itself off (with any ancillary equipment connected to the rear mains output socket) at the end of a reel of tape. Virtually the only mechanical feature which could be added to the deck is that of a pause control, to minimise the "click" or "bong" which is recorded on the tape when restarting.

A remote control traverse unit is available as an optional accessory.

The machine can be used as the heart of a stereo system using discs or tape. A magnetic cartridge can be played straight through the machine without the transport being used, i.e., the machine is used as a conventional audio amplifier. Accordingly, we measured the performance of the audio amplifier section as a first step.

The replay amplifiers in the unit are rated at 15 watts per channel or 20 watts music power. We measured 9.4 watts RMS per channel into 16-ohm loads just before the onset of clipping. Total harmonic distortion at 1KHz at this power was 1.2 per cent. With 8-ohm loads we measured 12.5 watts per channel at 1KHz for a total harmonic distortion of 2.5 per cent. Total harmonic distortion at a level of 1 watt into 8 ohms was 1.2 per cent. We did not measure power output into 4-ohm loads and we presume the amplifier was not intended for use with 4-ohm speakers. Indeed, there was no instruction in the owner's manual regarding the impedance of the external loudspeakers nor was there any indication on the circuit diagram.

We measured the frequency response of the amplifiers via line input at a level of 1 watt. To obtain the optimum frequency response we had to set the bass control to its extreme anti-clockwise position and the treble control at 12 o'clock. This gave a curve which was -3dB with respect to 1KHz at 26KHz and +7dB at 30Hz.

The treble control gave a range of plus or minus 5dB boost or cut at 10KHz and

Pictured is the X-330 recorder which has a very versatile tape transport mechanism. The machine can take reels up to 10½ in diameter and has excellent frequency response characteristics.



deliberately intended. In actual fact, the deck operation is quite straightforward. The tape transport itself is very complex, in spite of the use of three motors, which usually tend to simplify the mechanism. Five push-buttons on the right side of the deck control the tape transport via solenoids, while additional switches on the left side of the deck select forward or reverse operation and tape speed. Above the tape head cover is the four-position tape tension selector and above that the tape reversing counter and selector control.

On the lower left side of the deck are a pair of concentric level controls for the microphone and line inputs. Also in this control grouping is the speed equalisation selector. A rocker switch below this alters the equalisation (and also the bias level, we would presume) to suit standard or low-noise tape. Equalisation is to the NARTB curves. On the right lower side of the deck are bass and treble controls and concentric volume controls for tape or disc playback.

Two VU meters are provided for signal level monitoring but they are not calibrated. This would seem to be an unfortunate omission as it makes it difficult to reference levels to anything but what the manufacturers have adopted as "normal."

Also provided on the front panel are two jack sockets for microphones and a two socket for low impedance stereo headphones. A recessed panel in the side of the case accommodates loudspeaker outlets, line inputs and outputs, and inputs for a magnetic cartridge.

In operation, the machine is a pleasure to drive. The tape transport is very

\$4.50

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NEEDLE FORCE

GAUGE

If you're after real precision performance from your hi-fi equipment, every component part — from the largest right down to the tiny stylus tip — must be perfectly adjusted. For this reason, we recommend the use of the AR Needle Force Gauge. If stylus force is applied by spring tension, it is possible that the tension has varied. This, in turn, can result in reduced performance or even stylus damage! And this is where the AR Needle Force Gauge becomes invaluable. It will show the present stylus force and help you regain the perfect balance necessary for maximum performance.

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Distributors:

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NEW ALL TRANSISTOR STEREO AMPLIFIERS ULTIMATE IN DESIGN—LONG DEPENDABILITY USING ALL SILICON TRANSISTORS 36 WATTS—RMS

SPECIFICATIONS:

POWER OUTPUT: 18 watts per channel R.M.S.

Total output 36 watts R.M.S.

FREQUENCY RESPONSE: From 20 cycles to 20,000 \pm 1db.

HARMONIC DISTORTION: Less than 1 per cent at 14 watts output.

HUM AND NOISE: Aux. 70db, Mag. 50db.

INPUT SENSITIVITY: Mag. 3mv. Aux. and tuner 200 mv.

SPEAKER IMPEDANCE: 8 oms.

EQUALISED: Mag. RIAA.

TONE CONTROLS: Bass 50 c/s \pm 12db. Treble 10 kc/s \pm 12db.

LOUDNESS CONTROL: 50 c/s 10db.

SCRATCH FILTER: (High filter) at 10 kc/s 9db.

RUMBLE FILTER: (Low filter) at 50 c/s 5db.

PROVISION FOR TAPE RECORDER: Record or play-back with din plug connection.

PROVISION FOR HEADPHONES: with headphone/speaker switch on front panel.



MODEL C300/20

\$119.00 FREIGHT EXTRA.

DIMENSIONS: 16 $\frac{1}{2}$ in v 5 $\frac{1}{2}$ in x 11in deep.

Mounted in oiled walnut or teak veneered cabinet, with metal trim and matching knobs.

THE CIRCUIT INCORPORATES regular power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

**ABOVE AMPLIFIER
WITH INBUILT A.M.
TUNER**

\$144.00

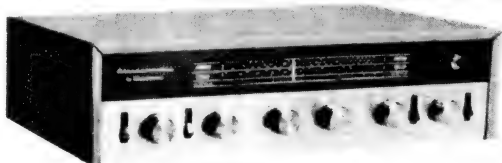
FREIGHT
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MODEL C300/20/T

12 WATT RMS PER CHANNEL VERSION OF ABOVE AMPLIFIERS AS PREVIOUSLY ADVERTISED
ALSO AVAILABLE. \$134.00 WITH TUNER.

NEW 24 WATT R.M.S. TRANSISTOR AMPLIFIER WITH INBUILT A.M. TUNER



MODEL C250

\$118.00 FREIGHT
EXTRA

DIMENSIONS 15 $\frac{1}{2}$ in x 4 $\frac{1}{2}$ in x 11in deep.
Cover finished in teak or walnut wood grain.
Incorporates 24 low noise silicon transistors plus 5 diodes.

SPECIFICATIONS:

POWER OUTPUT. 12 watts per channel 24 watts R.M.S. total (48 watts music power).

FREQUENCY RESPONSE. 20 Cycles to 20,000 \pm 1db.

HARMONIC DISTORTION. Less than 1% at 10 watts.

HUM AND NOISE. Aux. 70db, Mag. 50db.

INPUT SENSITIVITY. Mag. 3mv. Aux. 200mv.

SPEAKER IMPEDANCE. 8 ohms.

EQUALIZED. Mag. RIAA.

TONE CONTROLS. Bass 50c/s \pm 12db. treble 10kc. \pm 12db.

LOUDNESS CONTROL. 50c/s 10db.

SCRATCH FILTER. (High filter) at 10kc. 9db.

PROVISION FOR TAPE RECORDER. Record or play back with standard din plug connection.

TUNER. This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial



\$118.00

FREIGHT
EXTRA.

This amplifier is based on the Playmaster 118 circuit as featured in "Electronics Australia," to which has been added the following features:

- Inbuilt high gain A.M. tuner with a coverage of 530 to 1,600 K.C.
- Loudness control giving bass boost at low volume.
- Provision for tape, record and play-back, with din connector.
- Calibrated dial available for all States.
- EM84 tuning indicator giving accurate tuning with ease.

POWER OUTPUT: 9 watts per channel R.M.S. **FREQUENCY RESPONSE:** 20 to 20,000 cycles incorporating Ferguson O.P.412 gain oriented output transformers. **VALVES USED:** 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

**MODEL C200V. BASED ON THE
PLAYMASTER 118 WITH TUNER**

Dimension 16 $\frac{1}{2}$ in x 5 $\frac{1}{2}$ in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

the bass control gave a maximum of 8dB of boost at 50Hz in addition to that already inherent in the amplifier's response.

Akai tape recorders are unusual in that they use a separate head to apply the bias signal to the tape instead of applying it via the recording head. It is claimed that this technique results in less attenuation of the high frequency audio signals. Indeed, the frequency response specification for the machine is quite ambitious. At 7ips it is specified as flat from 30Hz to 25KHz within ± 3 dB; from 30Hz to 18KHz within ± 3 dB at 3ips and from 30Hz to 9KHz within ± 3 dB at 1-7/8ips.

An improved specification applies if "low-noise" tape is used, as follows: 30Hz to 26KHz within ± 3 dB at 7ips; 30Hz to 20KHz within ± 3 dB at 3ips and 30Hz to 13KHz within ± 3 dB at 1-7/8ips. It is good to see a different specification quoted for low-noise tape. Some manufacturers quote an ambitious performance without stating that low-noise tape must be used to realise the specification. For all our tests we used a high-quality standard virgin tape.

The record/replay characteristic was taken at a signal level 20dB below 0 VU using the line inputs and outputs. This means that the irregular frequency response of the power amplifiers does not enter into the measurement. Since the VU meters were not calibrated we took 0 VU to be the upper extreme of the "black" region of the meter scale.

At 7 1/2 inches per second we found the record/replay characteristic to be flat within ± 1 dB from 30Hz to 20KHz; at 3ips it was flat within ± 2 dB from 30Hz to 18KHz; at 1-7/8ips it was flat within ± 2 dB from 30Hz to 9KHz. Thus, the frequency response specification is comfortably met and this aspect of performance must be regarded as excellent. Total harmonic distortion at 0 VU was 2.5 per cent while the signal-to-noise ratio with respect to 0 VU was 40dB. These figures are not as good as those specified but are quite satisfactory. Separation between channels was measured at -40dB with respect to 0 VU at 1KHz.

To sum up, we found the machine performed very well, both in its mechanical functions and in electrical performance. Some aspects could be improved upon, however. The first of these is that the machine can too easily fall forward when used in the vertical mode. The feet-cum-handles are largely to blame for this plus the fact that the three motors and power transformer are all mounted at the top of the case, giving it a high centre of gravity. The manufacturer could improve the stability by the use of wider handles.

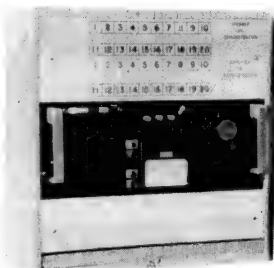
The vinyl-covered push-buttons on the deck are an ostentatious touch and may look "tatty" after a period of use, when the adhesive has aged. We would have preferred aluminium or even plastic.

While it is possible to make a direct comparison between the signal from the line or microphone sources and that recorded on the tape, it is not possible to make this same comparison between the magnetic cartridge signal and that recorded on tape.

Finally, we feel that the power amplifiers could be substantially improved for a machine in this price range, particularly with respect to harmonic distortion. Each amplifier comprises of four transistors and uses a driver transformer. The circuit design is, frankly, out of date, although we do admit that it is possible to obtain excellent performance from amplifiers using driver transformers. Akai, themselves, manufacture amplifiers which far surpass the performance of those in the X-330.

Unfortunately, first cost plus import duty puts this machine out of the range of all but the most "well heeled" tape enthusiast. The retail price is \$734. The machine is available from tape recorder retailers throughout Australia. Trade enquiries should be directed to the Australian distributors for Akai equipment, Akai Australia Pty. Ltd., 276 Castlereagh Street, Sydney, or interstate offices. (L.D.S.)

VEALLS' AUDITORIUM & COMPARATOR



A versatile audio comparator (right) installed in Vealls' auditorium (above). The comparator, built by the company's technical department, enables any pair of 10 sets of loudspeakers to be demonstrated with any one of 10 amplifiers and any one of six record players. The comparator is not available commercially, but further details may be obtained from Vealls Electrical & TV Pty. Ltd., 512 Bridge Road, Richmond, Victoria. 3121.

LAFAYETTE SOLID STATE REGULATED DC BENCH POWER SUPPLY

ONLY
\$69.50

SALES TAX
INCLUDED



- Automatic Protection Against Overload.
- Continuously Variable Output Voltage 5-13, 12-20 VDC at 0-2 Amp.
- Output Voltage Regulation ± 1 per cent.

Lab-type regulated DC bench power supply with dual-range voltage selector. Ideal for all types of transistor servicing and testing. Provides well-filtered, continuously adjustable DC output of 5-13 or 12-20 volts. Fully regulated with continuous output current of up to 2 amp. with less than 5 mV RMS ripple at full load. Self-restoring overload protection. Two D'Arsonval meters for constant monitoring of voltage and current output. Both input and output of power supply are fused for maximum protection. Input 115-120 or 220-240 VAC 50/60 Hz. Housed in rugged steel case. Size: 6 1/8" H x 4 1/2" W x 8 3/4" D. Stock No. 99-50775.

LAFAYETTE ELECTRONICS

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3-DIGIT DISPLAY



ADVANCE DT341

Digital Panel Meter

The DT341 range of Digital Panel Meters is designed for applications where a stable, accurate digital display, or A-D converter is required to be built into equipment. These units have a non-blink display, automatic polarity indication, and work on the dual slope integration principle. Their small size (5 in wide, 2.5 in high, 7.5 in deep), low cost and simplicity of fixing make them ideal units where accuracy, ease of reading and lack of ambiguity are of prime importance.

STANDARD MODELS AVAILABLE

DC Voltage Readings: 199.9mV to 999V.
DC Current Readings: 199.9nA to 199.9mA.
Resistance Readings: 199.9Ω to 19.99MΩ.

Buffered 1248 BCD output is fitted as a standard feature, with the signal and output grounds isolated from each other.

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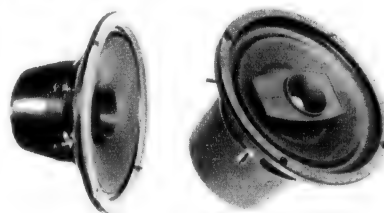
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TRADE RELEASES -- in brief

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mount Dandenong Road, Vic. 3136. Agents for Data General Corporation, U.S.A. **Supernova small computer.** The second in a family of small computers marketed by Fairchild (the first being the Nova computer). Features: full memory cycle using core 800nS; read-only memory cycle time 300nS; four full 16-bit word accumulators; core memory of 4,096 16-bit words; core memory expandable in 2K and 4K blocks to 32,000 words and physically interchangeable with read-only memory; teletype interface; input/output facilities include high speed data channel and automatic interrupt source identification. A new standard option on both the Nova and Supernova is multiply/divide hardware which is added directly to the central processor hardware. The Australian price for Supernova is \$13,175 including control console, 4K memory and teletype.

H. ROWE AND CO. PTY. LTD., 7 Flinders Court, Melbourne, 3000. Australian agents for Peak. **Hi-fi loudspeakers, models 8A7a and HS-201.** The 8A7a is an 8in twin cone loudspeaker with a music power rating of 8W, nominal frequency response of 60Hz to 15KHz, and available in either 8 or 16 ohms impedance. Retail



price \$9.50. The HS-201 is an 8in coaxial loudspeaker incorporating separate tweeter and mid/base loudspeaker. Nominal frequency range is 50Hz to 20KHz, music power rating is 20W, and impedance is 8 ohms. Retail price \$30.50.

GRANGER ASSOCIATES PTY. LTD., 1 Dale Street, Brookvale, N.S.W. 2100. Agents for Hatfield Instruments, U.K. **Psophometer, model 1000.** A low cost, active-network instrument which features telephone and/or broadcast weighting characteristics, as required by the C.C.I.T.T., obtained by front panel switching without external networks. Other features include: meter calibrated in dBm and voltage; external recorder may be used, without loss of accuracy, in addition to monitor headphone; level response from 50Hz to 20KHz in "flat" position; 2KHz plug-in active filter may be fitted for cross-talk measurements in telephone transmission systems; can make "weighted" noise measurements in the presence of voltages up to 300V DC; rugged but lightweight carrying case; in addition to conventional 600 ohm terminated and high impedance (through) connections, includes 600 ohm with centre tap to earth and high impedance with series capacitor.

MINNESOTA MINING AND MANUFACTURING (AUST.) PTY. LTD., 950 Pacific Highway, Pymble, N.S.W. 2073. **Professional audio recorder/reproducer model 401.** Two convertible models are available: a 2in 16-track console with NAB electronics, for which a head stack assembly is available to convert it to a 1in 8-track recorder/reproducer; a 1in 8-track recorder/reproducer which may be converted to a 2in 16-track with NAB electronics. Features of the 2in 16-track model include: adjustable tape guides for either 1in or 2in tapes; smaller than an average 4-track recorder/reproducer; adjustable

azimuth heads; compact remote overdub control. The company will also offer at a later date a 2in 16-track reproducer-only, model 402.

CRAMMOND RADIO MANUFACTURING CO. PTY. LTD., 463 Vulture Street, East Brisbane, Qld. 4169. Marine transceivers, **CTR70** and **CTR72** series. Type approved by the P.M.G.'s Dept., meet marine transceiver specification RB208, and have satisfactorily completed tests to comply with the requirements of schedules 2 and 3 of the Commonwealth Navigation (Radio) Regulations. These tests are very stringent and include vibration, bump, dry heat, damp heat, low temperature, and corrosion (salt water) tests.

SWE-CHECK INSTRUMENTS, 93 Cavanagh Street, Cheltenham, Vic. 3192. **FET-VOM** meter. Uses FET circuitry protected by zener diode. Weighs 14lb, and measures 6 1/2in high x 4 1/2in deep. Ranges: DC volts 0 to 1, 2, 3, 10, 30, 100, 300V and 1KV; AC volts 0 to 3, 10, 30, 100, 300V and 1KV; Ohms Rx1, Rx100, Rx10K, Rx1M (10 ohms, 1K, 100K and 10M centre scale respectively). Calibration accuracy on DC and Ohms is within 3pc and on AC volts within 5pc. Price, through leading wholesalers, is \$56 plus sales tax.

AMALGAMATED WIRELESS (A/ASIA) LTD., 348 Victoria Road, Rydalmere, N.S.W. 2116. Low power FM IF amplifier-demodulator, type **AWM1306**. A monolithic linear IC with principal applications in narrow-band FM receivers where low power-dissipation is important. It consists of a high gain 1MHz amplifier-limiter and a quadrature FM discriminator. Supply voltages are internally regulated, and the input impedance is set for matching typical ceramic IF filters. Complementary outputs from the discriminator provide for simple DC alignment and external bypassing is non-critical.

General characteristics: Package, 12-pin hermetic TO-5; maximum storage temperature, 150 degrees C; operating temperature range, 0 to 70 degrees C; supply voltage, 4.5 to 12V; power dissipation, 12mW (typical); RF gain, 90dB (typical); RF bandwidth, 1MHz at 3dB (typical); input impedance, 1.2K (typical); recovered audio, 200mW (maximum).

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3147. **PIN diode**, type **5082-3080**. Suitable for use as a current-controlled resistor in AGC circuits of mobile communications equipment, in TR switches and other applications where RF power needs to be controlled electronically. Features: frequency range 1MHz to 1GHz; distortion not greater than .05pc; cross-modulation products typically less than 0.5pc with respect to signal levels; second order distortion products below .05pc; RF resistance, controlled by DC forward bias, can be varied linearly between 5 and 2500 ohms; break-down voltages greater than 100V; DC power dissipation up to 250mW at ambient temperature of 25 degrees C; workable temperature range from minus 65 to plus 150 degrees C. Small quantity price is \$2.95, prices for larger quantities are available from the company.



PIN diode type 5082-3080.

Varian mini-computer



Representative of the very latest "state of the art" digital mini-computers is this unit, the Varian 620/f. It features a basic cycle time of only 750ns, which Varian claims to make it the fastest small computer currently available. Although fully compatible with all software written for earlier models in the Varian 620 series, the new machine offers not only a 2:1 speed increase but also a number of new instructions, optional 300ns read-only memory, direct memory access, and facilities for up to 32 input/output or storage peripherals. (Varian Data Machines — Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065.)

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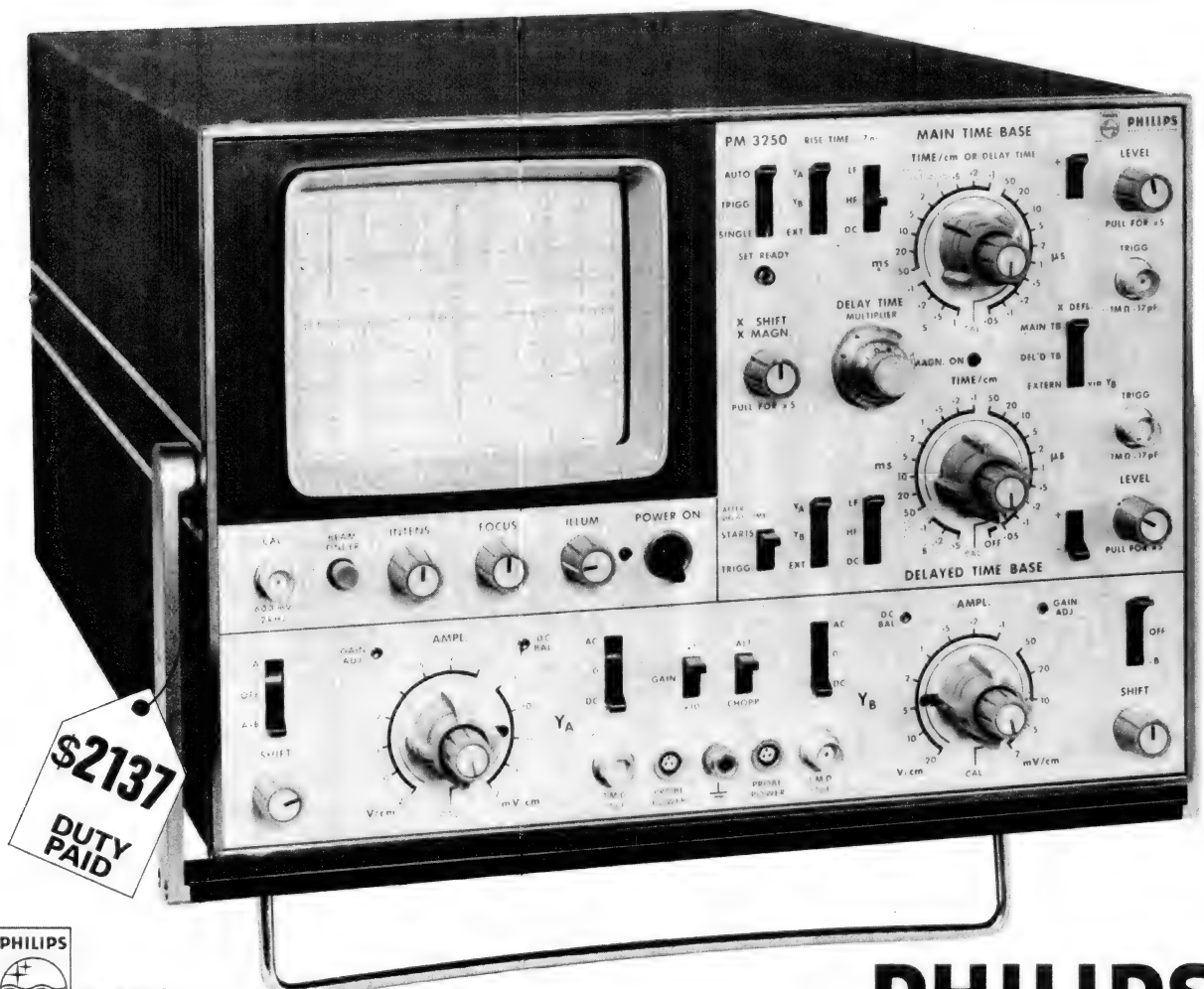
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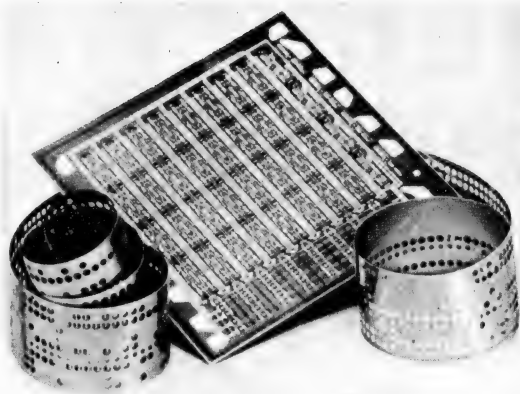
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MOS Random Access Memory

MOTOROLA SEMI-CONDUCTOR PRODUCTS, 37-43 Alexander Street, Crows Nest, N.S.W. 2065. MOS random access memory, type MC1170L. A high performance, low cost 64-bit random access memory for use in 500nS or less access time systems. Organised as 16 words of 4 bits each and fabricated from P-channel enhancement mode devices, the MC1170L uses four-input binary addressing with full decoding performed on the chip. An enable input is also provided for easy address expansion. Read/write buffer circuits on the output bit lines allow as many as 20 bit lines to be "wired ORed". System timing is not critical because of the single-phase clock used by the device.

Power dissipation of the MC1170L is



A master photograph of the Motorola MC1170L random access memory.

about 325mW when operating from 30V and 15V sources. It is supplied in a 14-pin dual-in-line package for operation over the 0 to 75 degrees C temperature range. The price of the MC1170L is \$13.70 in 100-up quantities.

RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113, has announced the following appointments. Mr Aub Roberts as production manager. Prior to joining Racal, Mr Roberts held senior positions with T.E.I., Hills Electronics and Centre Industries. Mr John McGivern as chief accountant. Mr McGivern was previously senior accountant with T.E.I. Mr Maurice Bowman, previously Racal purchasing officer, has been promoted to supply manager.

BRITISH MERCHANDISING PTY. LTD., 49-51 York Street, Sydney, 2000, has announced that Mr Julian W. Dinsdale, senior electronics sales engineer for the B.M.P. group of companies, has recently returned from an extended overseas visit. Mr Dinsdale visited Derritron Electronics, Vibrators Ltd. and Racal-Thermionic Ltd. for whom British Merchandising and Tape Recorders Pty. Ltd. are sole Australian agents. As a result of his visit the B.M.P. group is extending the consultancy and after-sales back-up service facilities for the vibration testing and data acquisition systems.

HAWKER SIDDELEY ELECTRONICS LTD., 752 Pittwater Road, Brookvale, N.S.W. 2100, has appointed Mr G. J. Donnan as commercial director of the company. Mr Donnan is responsible for corporate marketing and planning both in Australia and overseas. Mr Donnan is also a director of Ferris Bros. Pty. Ltd., Allied Capacitors Pty. Ltd., and other subsidiaries.



G. J. Donnan

J. Wiggins

MOTOROLA SEMICONDUCTOR PRODUCTS, a division of Motorola Australia Pty. Ltd., 37-43 Alexander Street, Crows Nest, N.S.W. 2065, has appointed Mr Jim Wiggins as sales engineer. Mr Wiggins was formerly with Cannon Electric (Australia) Pty. Ltd. in Sydney.

AUSTRALIAN GENERAL ELECTRIC PTY. LTD., 103 York Street, Sydney, 2000, has appointed Mr John McKim as general manager, Information Systems, with responsibility for the company's business computer operations, including equipment sales, field engineering services, time-sharing and batch processing. Previously, Mr McKim managed the equipment sales and field engineering aspects of Information Systems. He succeeds Mr Barry Eames, who has accepted the position in the U.S.A. of marketing manager, GE-265 Time-Sharing Plans and Programs, responsible for the development of 30 time-sharing centres throughout the U.S.A.

PLESSEY PACIFIC PTY. LTD. has appointed Mr Edward Fair as the company's purchasing executive. Mr Fair was previously general purchasing manager with Massey-Ferguson (Aust.) Ltd. He is a Fellow of the Australian Institute of Management and a Member of the Institute of Business Administration.

AKAI AUSTRALIA PTY. LTD. has announced the winners of the Akai sales promotion contest for 1969. The first prize, won by Douglas Trading Pty. Ltd., of Melbourne, consists of a 26-day tour of the Orient by Qantas, including 13 days in Japan and visits to Hong Kong, Bangkok, Taipei and Singapore. Mr B. J. Douglas and his family leave for the trip on May 9. The second prize, an 18-day tour of Japan and Hong Kong, was won by Ence Electronics (Sales) Pty. Ltd., Sydney. The Sydney manager, Don Oates will be taking this trip. Other major prize winners were Telair, Brisbane (10-day tour of Fiji), Mastertone Elect., Dee Why, N.S.W. (10-day tour of Fiji), and Sunstrom Elect., Adelaide (set of golf clubs).

H. M. COMPONENTS & CO., P.O. Box 14, Williamstown, Vic. 3016, has been appointed sole Australian agent for W. S. Suddentsche Gluhlampen Fabrik, the German manufacturer of miniature lamps. The W.S. range comprises a fully comprehensive selection of indicator lamps.

VEALLS ELECTRICAL & TV PTY. LTD., 512 Bridge Road, Richmond, Vic. 3121, has opened a specialised division for hi-fi stereo and audio equipment. A spacious, carpeted lounge with comfortable chairs and settee has been provided for customers. A special audio comparator enables any two pairs of loudspeakers to be demonstrated from any one of ten stereo amplifiers. Change over is effected in three seconds.

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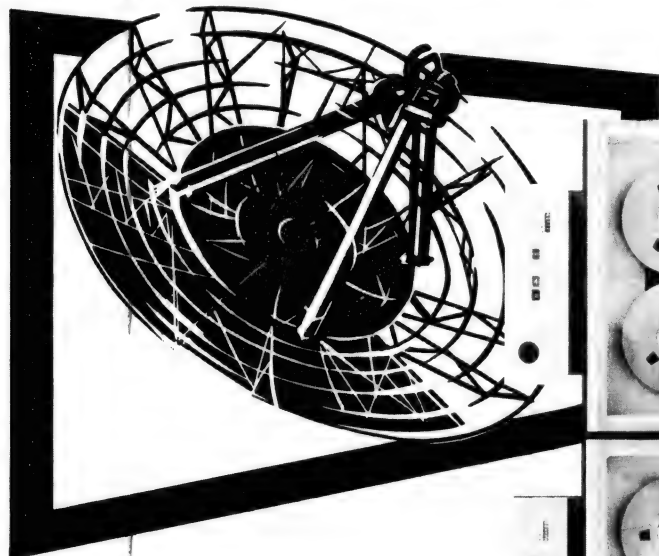
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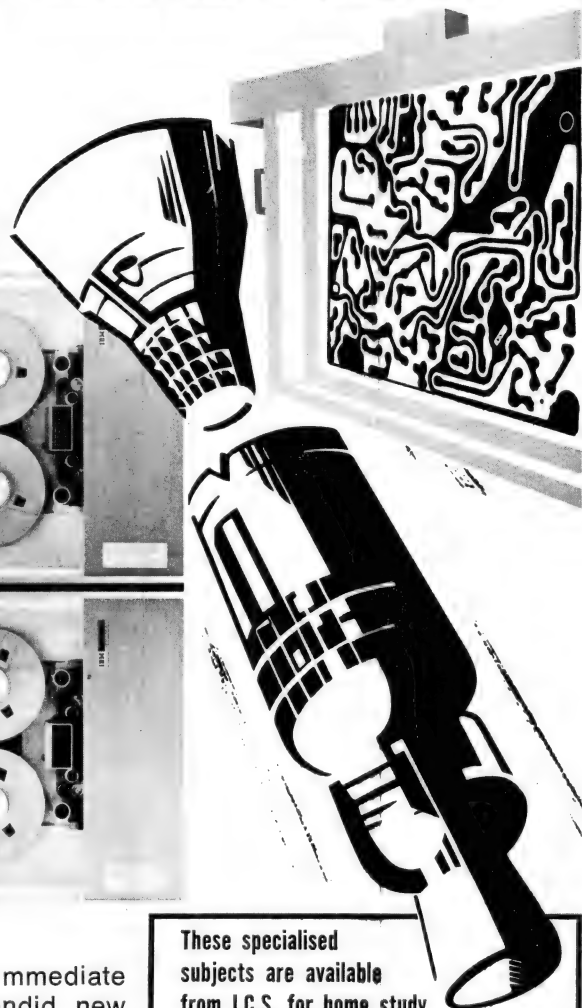
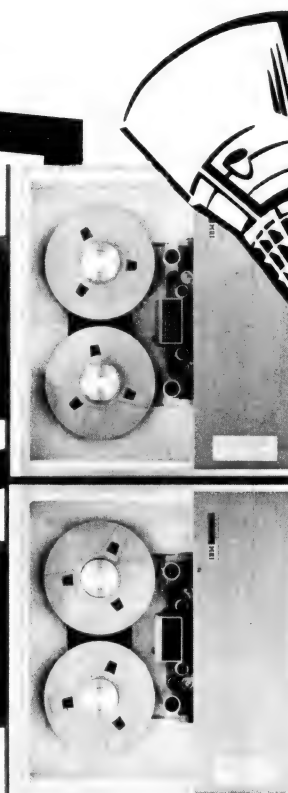


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TECHNICAL BOOKS AND PUBLICATIONS

Rockets, missiles . . . and electronics

ROCKETS AND MISSILES by John W. R. Taylor. Hamlyn all-colour paperback published by Sun Books, Melbourne. Stiff paper cover, 160 pages, 7 x 4 inches. Price in Australia and New Zealand 99c.

This is not a book about electronics but it does cover devices which, teamed with electronics, have more than anything else dramatised the progress of modern science and technology. The author, W. R. Taylor, is well qualified to tell the story of rockets and space flight, being a product of the aircraft industry and Editor of "Jane's All The World's Aircraft."

The first chapter outlines the early history of rocketry and the reader is reminded that the story of the rocket as a weapon stretches back over something like 1000 years.

A second section, involving some fifty pages, takes up the story from Hitler's buzz-bombs and V2 rockets, tracing the development of missiles and their control systems to the relatively sophisticated weapons of the present

day. Included in this section are anti-aircraft, anti-tank, anti-submarine and other such weapons, infantry and airborne missiles and, of course, the larger ballistic missiles right through to the ICBMs.

Less foreboding is the section "Rockets Into Space" which again starts with the German V2 but which traces the efforts of scientists to probe the mysteries of space and then of space travel. All of this will be in the living memory of many readers but it is a story which easily stands re-telling.

This leads naturally into a section "Reaching For The Moon," a series of achievements which concentrates very largely in the past eleven or twelve years. The author recounts the historic flight by Armstrong and Aldrin, then takes a brief look into the near future at proposals for a manned orbital laboratory, aerodynamic spacecraft and other devices which are currently at the top of the list in space programs.

A book which is packed with interesting information and right up to the minute. Our copy came from the publishers. (W.N.W.).

1970 Handbook

THE RADIO AMATEUR'S HANDBOOK Published by the American Radio Relay League Inc., Newington, Conn., U.S.A. Ample illustrated with line drawing and photographs. Soft cover, 643 pages, 9 1/4 x 6 1/2 in.

This, the 47th edition of what has become, perhaps, the most widely used reference text for radio amateurs remains basically unchanged from previous editions, although considerably updated in many sections.

Fundamentals, because they are fundamentals, remain essentially unchanged. For this reason the early chapters dealing with basic theory and components are virtually identical from year to year. There is, however, an increasing emphasis on solid-state devices and their application, both in the theory chapters and in the more specific material presented later in the book.

The application and construction data includes a lot of new material and is consistent with the current state-of-the-art in this rapidly developing field.

The chapter dealing with HF receivers includes designs suitable for relatively inexperienced constructors, together with more advanced designs suitable for amateur station use. Transmitter construction employs recent valve types, some of which are well beyond the pocket of most local ama-

teurs but, perhaps fortunately, also well beyond the legal power limit applicable in Australia.

It is in the chapters dealing with VHF and UHF techniques that the increased emphasis on solid-state devices is most evident. None of the receiver designs employs valves of any type, preference being given to JFET and IGFET application. Several low-power solid-state transmitters are also described.

Aerial design and construction are covered in a manner which permits the amateur to satisfactorily develop a system or systems tailored to his own specific needs without slavishly following someone else's pattern. Just sufficient maths is introduced to enable the necessary design calculations to be made with a minimum of effort.

The section exhibiting the greatest change is that dealing with mobile techniques where a wide range of equipment, both HF and VHF, is described. This is in keeping with the apparent upsurge of interest and activity in this mode of amateur operation.

The valve data at the end of the book is adequate for most "ham" requirements although the semiconductor section is not perhaps as comprehensive as might be expected.

This is a handbook which can be confidently recommended to those desiring to break into the highly interesting field of amateur radio. The

reproduction of the construction photos, together with the quality of printing are of the highest order.

Our review copy came direct from the publishers in the U.S.A. but this volume is available locally through technical booksellers in each State. The soft cover edition is listed at US\$6.00 with a hard cover edition available at US\$8.00. Australian prices will normally be somewhat higher. (A.D.N.)

About the weather

THE WEATHER GUIDE, by A. G. Forsdyke, B.Sc., Ph.D., A.R.C.S. Published by Paul Hamlyn, London, and Sun Books, Melbourne. Colour paperback series, glossy cover, 160 pages, 7 in x 4 in, freely illustrated in full colour, and with numerous diagrams and charts. Price in Australia and New Zealand, 99c.

"From biblical times to the present day weather forecasting has attracted considerable interest. Its exponents have included the charlatan and soothsayer . . . shrewd observers of wind and sky like farmers and sailors; and the modern scientific meteorologist. This book has no more to say about the first group; it is concerned with weather study as a science, but it recognises the wisdom, expressed in weather lore, of those whose livelihood is earned out-of-doors."

That quotation from the foreword to this book sums up its aims quite nicely. (The final statement may be taken as an admission that the ancient rule of thumb predictions of the country dweller occasionally prove more accurate than the results of the complex meteorological networks now operating.)

The book has all the usual hallmarks of the Hamlyn all-colour paperbacks. The author is highly qualified (40 years experience with the U.K. Meteorological Office); the text is concise and factual, but tending to be superficial; and there are the usual very attractive and informative full colour illustrations on virtually every page. Mr Forsdyke has bent over backwards to avoid blinding his readers with science, but unfortunately he appears to be too close to his subject to avoid leaving some doubts in the reader's

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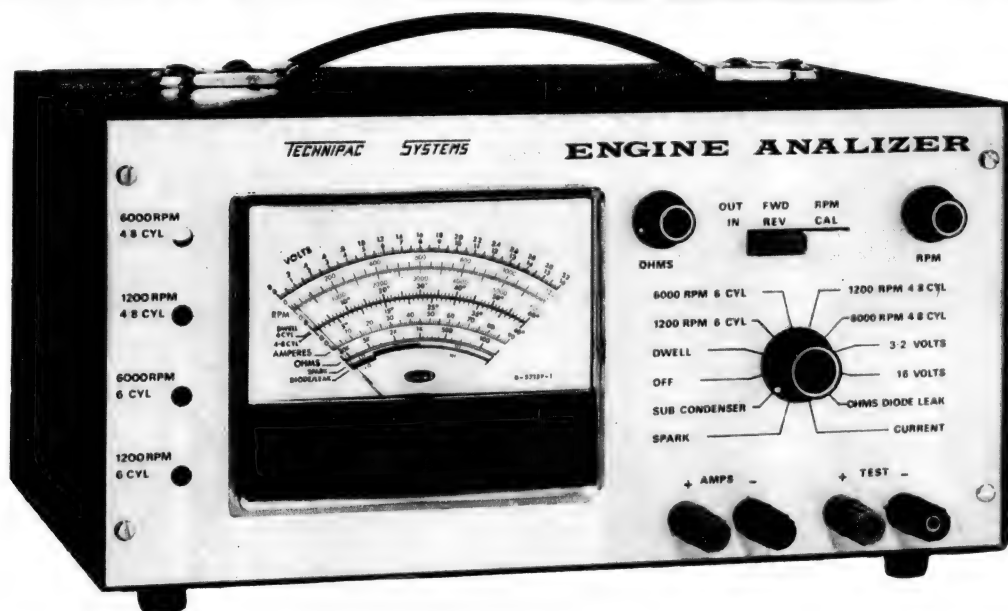
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mind in a few places. Also, he is apparently not an experienced author, and has the disturbing habit of referring his readers to subject matter not yet covered in the text, some 20 or 30 pages ahead.

Apart from these defects, which are not really serious, the book may be regarded as successful. Despite Mr Forsdyke's localised experience, he does not restrict his account to U.K. conditions, but covers all parts of the world. He explains the factors which influence weather, such as temperature, atmospheric pressure, wind and radiation; weather conditions, with a particularly interesting section on clouds; weather maps and forecasting, with explanations of the peculiar lines and symbols on weather maps which are apt to confuse the layman; climate (past as well as present) in different parts of the world. The final chapter deals with the problem of air pollution, and the basis of the old weather lore. A list of suggested further reading is included.

No prior knowledge of the subject, or for that matter any special knowledge at all is required of the reader. In some places the desire to simplify appears to be taken to extremes (it hardly seems necessary to explain that heavy rain will sometimes transform drought areas into flood areas). However as first reading into a fascinating subject, the inexpensive and attractive little book has much to recommend it. (H.A.T.).

Photoelectronics

PHOTOELECTRONIC DEVICES. By J. B. Dance M.Sc., B.Sc. Published 1969 by Iliffe Books Ltd, 42 Russell Square, London, W.C.1. Hard covers, 172 pages 8½ x 5½ inches, illustrated by diagrams and circuits.

With the enormous amount of research that is currently going on into display and other electron-optical devices, this book by J. B. Dance is timely. With a Master's degree from Birmingham University, the author gained experience at the Harwell Atomic Research Establishment, held a number of lecturing posts and is now back at the Birmingham University, researching neutron detection and scintillation counters.

Chapter 1 of the new book, entitled "Introduction" provides a brief but effective survey of the integration of photons with matter, including mention of the relevant units.

Chapter 2, involving 17 pages, provides a brief but basic survey of semiconductor fundamentals, with appropriate emphasis on photoconductive and photoemissive effects.

This leads into a study of photoemissive materials and photocathodes of various types, which have provided the basis for generations of evacuated and gaseous phototubes. In fact, the next two chapters deal at some length with the nature and circuit applications of two-element phototubes (referred to as photoemissive diodes) and the much more complex photomultipliers.

In chapter 6, page 88, the author leaves behind glass envelope devices for "Homogenous Semiconductor Photodevices" including cadmium sulphide

and cadmium selenide cells and such-like.

Junction photodevices are covered in chapter 7, their principles and typical circuit applications. One notes mention of photodiodes, readout cells, solar cells, selenium barrier layer cells, phototransistors, light-actuated PNP devices and integrated circuit photodetectors.

The remaining chapters deal with image intensifiers and converters and with electroluminescent devices.

Of particular note is the comprehensive bibliography which is provided at the end of each chapter. This and the index round out what should be a most useful addition to the literature on this important subject.

To gain maximum value from the book, the reader would need to be familiar with electronic terminology and have a background in physics. However much useful information could be derived by anyone interested in the subject having only an electronic background. Our copy came direct from the publishers but supplies should be available in due course through technical booksellers. (W.N.W.)

Solid State

DOPING AND SEMICONDUCTOR JUNCTION FORMATION by Marshall Sittig. Published by Noyes Data Corporation, Park Ridge, N.J., 1970. Soft covers, 8-3/8in x 10½in, 318pp., many diagrams. Price in U.S.A. \$35.

This volume is the latest release in Noyes Data Corporation's series "Electronics Materials Review," which are specifically intended to supply information on recent developments in technology for those in management, research, engineering development, marketing, and education.

Like the other books in this series, Doping and Semiconductor Junction Formation is basically an in-depth review of the specific content of recent U.S. patents in the field concerned. As such it is intended to provide a concise, accurate and up-to-date reference of the current state of the art, a reference whose content should be considerably in advance of that in currently published texts, journals and other reference literature.

The content material in the present volume is grouped under the following general headings: 1—Introduction; 2—Production of Alloyed Junctions; 3—Diffusion Processes; 4—Melt Grown Junctions; 5—Doping During Melting; 6—Simultaneous Doping and Substrate Deposition; 7—Spark Doping Processes; 8—Doping by Particle Bombardment; 9—Hydrothermally Grown Junctions; 10—Doping Epitaxially Grown Layers; 11—Future Trends.

In each section the processes and techniques are discussed thoroughly and concisely, illustrated in most cases by coded patent-form diagrams. Full details are given of the individuals and companies associated with a process and its patent, the author stressing in his foreword that great care has been taken to ensure that this information is not only reliable and comprehensive, but also sufficiently detailed to avoid legal criticism for "insufficient disclosure."

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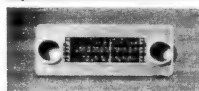
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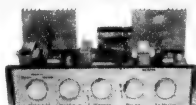
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The book is quite unpretentious in form, with unjustified text whose appearance suggests photocopying from an electrically typewritten manuscript. On superficial examination this may suggest that the book is somewhat overpriced. However, in view of the wealth of concise practical information which it provided on the "fine details" of current semiconductor technology, it should be found of very great value not only by those in industry and research, but also by lecturers and students involved in engineering courses at both graduate and undergraduate level.

The review copy came directly from the publisher, whose address is Noyes Building, Park Ridge, New Jersey 07656, U.S.A. (J.R.)

LITERATURE—in brief

MULLARD OUTLOOK, Vol. 13, No. 1, January-February, 1970. Published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W. 2000. Contents: Viewpoint with Mullard; Digital integrated circuit applications, part 2; Mullard pot core substitution; Junction field effect transistors; Mullard at the 1970 Physics Exhibition; New planar transistors for switching 150W pulses; New Gunn effect devices; Integrated circuit cross reference. Also included with this issue is the Table of Contents for Volume 12, 1969.

PLESSEY ELECTRONICS PTY. LTD., 91 Murphy Street, Richmond, Vic. 3121, has published product data sheets which give details of high stability, close tolerance, quartz crystal units designed and manufactured for the telephone, computer, electronic, aircraft, and radio communication industries. Units described include: the P-2 (Model HC6U), available in a frequency range 800KHz to 100MHz in a sealed, plated and wire mounted unit filled with an inert gas; the P-3 (Model HC18U), subminiature, plated wire mounted assembly with a frequency range of 5 to 100MHz, supplied in a hermetically sealed gas-filled holder.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., Private Mail Bag, Ermington, N.S.W. 2115, has available the following publications of RCA Electronic Components, U.S.A. **RCA Solid-State Product Guide**. Lists brief specifications for the RCA range of semiconductors including transistors, diodes, rectifiers, thyristors, integrated circuits, photoconductive devices and an infrared emitter. **RCA MOS Field Effect Transistors Product Guide**. Includes construction, features, quick selection guide, ratings and typical characteristics, typical transfer characteristics, typical circuits, application notes, and dimensions.

USING THE 675A/676A NETWORK ANALYZER AS AN EDUCATIONAL TOOL, Application Note 112-2, published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. A 17-page application note, useful for both the instructor and student, describes frequency behaviour of electrical networks. Demonstrations illustrate frequency swept transfer and driving point measurements displayed on a conventional oscilloscope. Included with each application note is a Nichols chart oscilloscope CRT overlay to predict the closed loop behaviour of feedback network designs.

WORLD TELECOMMUNICATION DAY, May 17, 1969. Booklet No. 5, published by the International Telecommunication Union, Place des Nations, 1211 Geneva 20, Switzerland. Paper covers, 5 1/2 x 8 in, 106 pages with several photographs. Price, 2 Swiss francs. A

Free publications from Radio Nederland

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Radio Nederland has published a number of data sheets on the following subjects: selectivity improvement; the Q-multiplier; image frequencies; a beat frequency oscillator; transistorised crystal calibrator; product detector; the BC-221 frequency meter; the frame aerial as a directional medium wave aerial. Two non-technical items available are: This is DXing; and an English-Spanish DX Vocabulary.

Radio Nederland's technical courses, previously broadcast in "DX Juke Box," have been re-issued in the form of postal tuition. The following are available: Shortwave Propagation Course; All Round DXers' Course; DX Receiver Course; DX Antenna Course. Enrolment is accepted for one course only at a time.

The various booklets, data sheets and courses are obtainable free of charge from DX Information Service, c/o Radio Nederland, P.O. Box 222, Hilversum, Holland. Inquirers should state clearly what is required, and print name and address in block capitals.

special brochure giving an account of the information received by the I.T.U. and showing the efforts made by all those countries who took part in the first World Telecommunications Day.

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tary-General of the International Telecommunication Union; Messages of congratulations received from United Nations Specialised Agencies and other sources; Celebration in Geneva of World Telecommunication Day; Celebrations throughout the world (reports of activities in 91 member countries).

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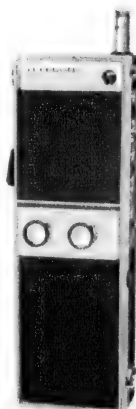
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The Standards Association of Australia, 80 Arthur Street, North Sydney, N.S.W. 2060, has published the following:

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AS C179, air conditioners. Prescribes construction, marking and testing requirements for electrical approvals purposes for

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AS C182, frozen food cabinets. Sets out construction, marking and testing requirements for approvals purposes for refrigerated food commercial cabinets for use at low and medium voltage. Applies to cabinets with either a self-contained or remote refrigerating unit. Price 80c.

AS T43 diathermy equipment. Specifies requirements for the performance and use of microwave, short-wave and long-wave diathermy equipment, including associated component parts, for surgical and therapeutic services. Price 80c.

AS Z24, methods of test for pressure sensitive adhesive tapes. Method 17.1 (revision), resistance. Specifies apparatus and procedure for determining resistance to solvent of electrical tapes by shear strength after immersion in solvent. Method 19.1, flammability. Describes apparatus, test specimen and procedure for determining the burning characteristics of tape wound on a brass rod and ignited. Price 40c each.

HEWLETT-PACKARD JOURNAL, Vol. 21, No. 6, February, 1970. Published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. Contents: A system for automatic network analysis; Software for the automatic network analyser; Developing accuracy specifications for automatic network analyser systems; Applications for the automatic network analyser; Specifications of the Model 8542A Automatic Network Analyser.

MARCONI INSTRUMENTATION, Vol. 12, No. 4, 1969. Published by Marconi Instruments Ltd., U.K. Inquiries to Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents: Transmission systems; All solid-state sweeper covers HF and VHF bands; Testing SSB transmitters; PCM testing techniques; Counter type TF 2411; Wide band precision frequency meters, type 6049 series.

MEASUREMENT NEWS, November/December 1969. Published by Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146. Contents include: New network analyser; Keyboard extends computing counter uses; Amplifiers for data acquisition systems; 4-channel instrumentation recorder; DC amplifier has 110dB range; Printout for programmable calculator; Caesium beam standard; Computer-controlled automatic test system.

TECHNICAL COMMUNICATIONS, Vol. 11 No. 102, November, 1969. Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Monochrome TV power supplies for 117V and 220V mains inputs; Thyristor power supplies for colour TV receivers; Luminance, colour-difference output, synchronising and AGC circuits; Thermostatic fan control for central heating.

HEWLETT-PACKARD JOURNAL, Vol. 21, No. 5, January, 1970. Published by Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Glen Iris, Vic. 3146. Contents: A DC-to-VHF oscilloscope; A fast-writing, high-frequency cathode-ray tube; A wideband oscilloscope amplifier; Monolithic transistor arrays for high-frequency applications;

A fast time base for a high-frequency oscilloscope.

WATVIC SCIENCE RECORD, Vol. 4, February, 1970. Published by Watson Victor Ltd., P.O. Box 100, North Ryde, N.S.W. 2113. Contents: Mettler substitution balance; LKB Uniphor electrophoresis apparatus; Toa blood-cell counter; Radiometer blood gas electrode unit; Qualtex laboratory ovens; RZR stepless speed stirrer; Weller temperature-controlled soldering iron; Toshiba photoelectric tachometer; Nikon stereoscopic zoom microscope; API digital panel meters; Goertz miniature potentiometric recorder; Goertz universal multi-range instrument; Buehler metallographic equipment; Rollei close-up camera.

MULLARD BULLETIN, Integrated Circuit Extra, November, 1969. Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Southampton factory expansion; IC manufacture — a process outline; Around the clock computer control; Testing is automatic and easy; Quality control, testing and reliability; TTL reference guide; Room for development; All about Mullard ICs — families, data, application notes.

FR-PET. Published by Teijin Ltd. Japan. Inquiries to Holmesdale Pty. Ltd., 299 Kent Street, Sydney, 2000. An 18-page booklet describing Teijin's FR-PET glass fibre reinforced polyethylene terephthalate moulding resin. It tabulates the grades and physical properties of FR-PET, discusses its useful attributes and its defective points, gives some suggested applications, and compares FR-PET with various other moulding materials.

NEW DEVELOPMENTS, Issue B047, February, 1970. Published by Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, 2000. Contents: Telonic tri-colour CRT display system; Waveline direct reading frequency meters; Alfred push-button control unit and plug-in container unit; TRW transistors types PT6669, TP6618, PT6635 and PT6636; Weinschel broadband microwave head; Mycalex series 5 digital data systems; Houston X-Y recorder; Dana digiphase synthesizer; Norma multi-range precision AC meter; EECO fast access magnetic tape unit; Kyoritsu panel mounting meters.

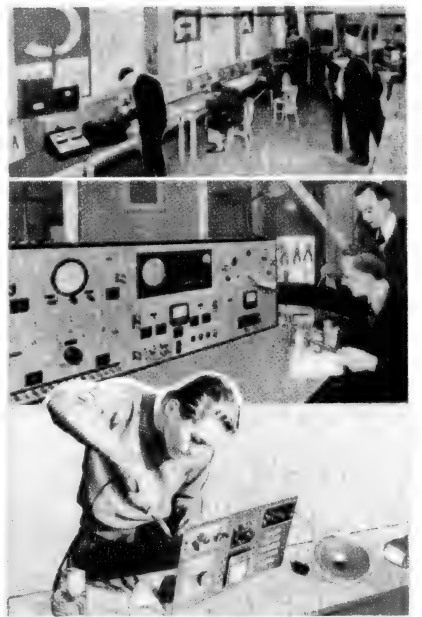
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AMATEUR BAND NEWS AND NOTES

All India Amateur Radio Convention

The official report of the First All India Amateur Radio Convention, held in Bombay last December, contains information which should be of interest to all who are interested in the growth of international amateur radio, particularly in Region III.

by Pierce Healy, VK2APQ

As a guest of the Convention committee in Bombay from December 24 to 30, 1969, it was my great pleasure to hear the discussions and to learn first-hand the problems that beset the progress of amateur radio in India. It was also my privilege to meet the Minister of State for Communications, the Chief Adviser of Wireless to the Government, and other Government and business executive officers who attended the convention.

During the course of the Convention it was most interesting to meet individual amateurs, among whom was G. V. Sulu, VU2GV, whose name and work in amateur radio circles have been featured in these notes; also shortwave listeners and many others, to discuss common interests and to answer questions on amateur radio in Australia. It is of interest to note that during his inspection of the official convention amateur station, VU2HAM, the Minister of State for Communication spoke to Brian Warren, VK2BX, of Sydney.

To the committee, fellow amateurs and my host, Dave Dalrymple, VU2OLK ex GM3OLK, I express my deepest appreciation for the hospitality and friendship extended to me during my visit. It was an experience, both from the social and educational points of view, and I am truly grateful for the invitation that was extended to me.

The Official Report issued by the Convention Committee has now come to hand, and is published below in full (except for the speeches by Professor Sher Singh and Shri N. C. Srivatsava referred to in the text, which had to be omitted for space reasons).

OFFICIAL REPORT

The program of the convention began with the opening of the Amateur Radio Exhibition on December 24, at 5 p.m. Shri K. M. Balchandani, Direc-

tor General, Overseas Communication Services, inaugurated the exhibition. The leading radio and electronic manufacturers participated in the exhibition. Philips Tata Electric Companies, Nelco, Photophone, Bush, S. R. Standard, Telerad, Cema Vibronics and Asian Electrics had attractive stalls. Bush, Telerad and S.R. Standards Radio gave live demonstrations of television. (Note: There is no television in Bombay.)

The Home Guard, Civil Defence, Atomic Energy Commission and Police Wireless also had displays that were very interesting and informative. A very illuminating assortment of amateur gear (home constructed) was displayed. A working amateur station with the special call sign VU2HAM was in operation and attracted great interest in the DX world. A record number of contacts were made from the station.

A large multitude of people visited the exhibition. Besides witnessing the latest electronic, radio equipments and instruments, they saw for the first time a working amateur radio station in this exclusive Amateur Radio Exhibition and learnt about this glorious hobby. Over 100,000 people visited the exhibition between December 24 and 30, 1969.

Two hundred delegates, which included 75 per cent of the total active amateurs in India, from nearly 60 cities, arrived on December 26 to participate in the convention from December 27 to 30, 1969. This convention was sponsored by 16 different amateur societies and clubs out of a total of 17 from all over India. Delegates also came from DX countries. A total of 271 delegates registered for the convention. A very informative souvenir book was published to mark the occasion.

The convention was inaugurated on December 27, at 5 p.m. by Professor Sher Singh, Minister of State for Communications. Shri Y. A. Fazalboy, chairman of the steering committee welcomed the delegates and the chief guests. Shri B. S. Dutt, VU2AJ, chairman of the executive committee gave a resume of the preparations lead-

ing to the convention and underlined the highlights and the theme.

In reply Professor Sher Singh made a very inspiring speech, the text of which is included in the report. Shri Dave Dalrymple, VU2OLK, chairman of the Souvenir and Exhibition Committee, proposed the vote of thanks. Prof. Sher Singh was taken on an inspection of the stalls in the exhibition and when he visited the amateur station VU2HAM, he spoke over the radio to amateurs to convey a message of goodwill.

Delegates were hosted to dinner by the Radio, Electronics and Television Manufacturers' Association to welcome and meet them.

The business of the convention began at 9 a.m. on December 28, 1969. The first seminar "Amateur Radio in India" was presided over by Lt.-Col. Dady S. Major, VU2MXD. Interesting papers were read and lively discussion took place. At the end of the seminar, Shri V. M. Gogte, Wireless Adviser to the Government, addressed the gathering on the necessity of increasing the activity on the amateur bands. He appealed to the amateurs to be more active and encourage formation of clubs in schools, colleges and technical institutions.

He stressed the point that the cautions sent to amateurs by the Wireless Planning and Co-ordination department of the ministry of communications for violating certain rules and regulations were only for corrective action and were not intended as a punishment. He conceded that it does take some time to issue the licence initially, but once it is issued, it remains for good with the licensee.

He then answered a number of questions from delegates on all problems brought to his notice and this was a very illuminating encounter indeed. Delegates were happy that for the first time they had the opportunity to meet the Wireless Planning and Co-ordination chief in person and to discuss their problems with him.

The other three seminars, namely — Technical Aspects of Amateur Radio; Amateur Radio Service and the Nation; and The Union of Amateurs — were presided over respectively by Shri V. J. Bhatt, VU2RX; Comdnt. Gen. Udayan Chinubhi, VU2UD and B. S. Dutt, VU2AJ. Again very interesting papers were presented and lively discussion followed. A separate report is being prepared.

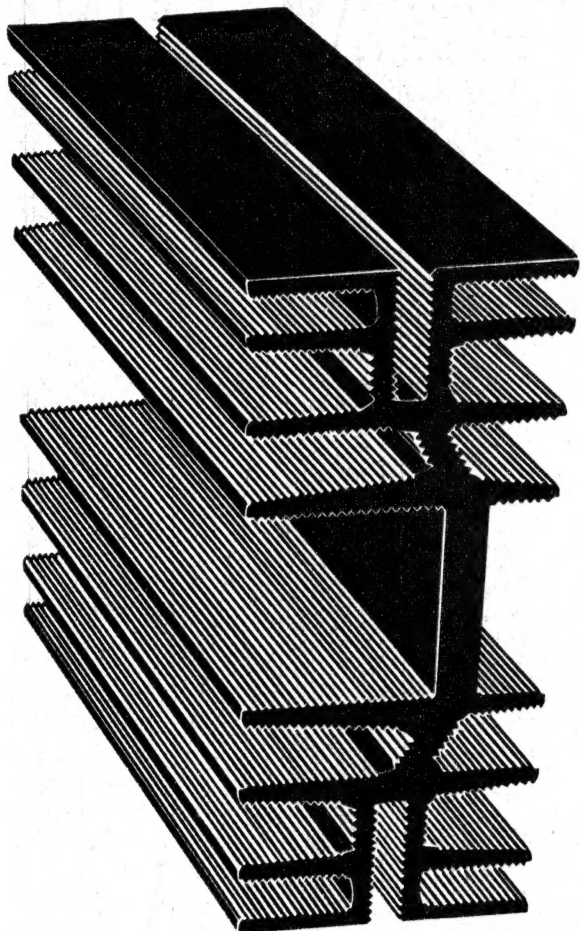
Two very interesting lectures were presented during the convention. Pierce Healy, VK2APQ, spoke on important aspects of amateur radio and detailed the services rendered by amateur radio to the nation and society in his country. He also gave details of the launching of Australia's Oscar V and how the

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.



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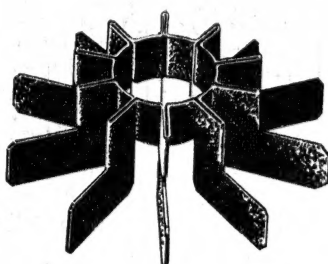
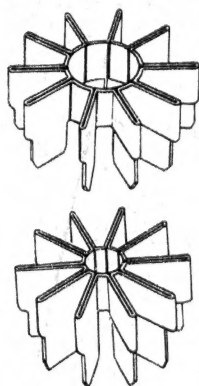
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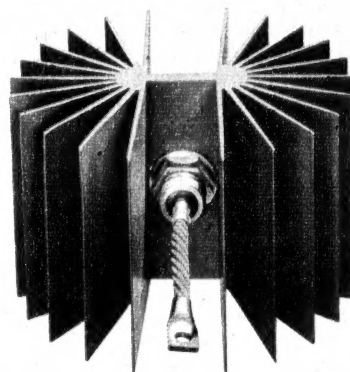
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VU2s could observe telemetry and other data from it. The talk was supplemented by colour slides and a colour movie of field-day activity. Delegates expressed gratitude to Pierce Healy for his well-planned talk and all the trouble he took to join the convention and give us vital information on important aspects of amateur radio.

Another interesting lecture was given by Major J. K. Deshpande, VU2ED, which was equally illuminating and informative with practical demonstration of making up a single-sideband crystal filter, which was very much appreciated by the delegates.

The chief guest for the plenary session on December 30, 1969, was Shri N. C. Srivatsava, Secretary Ministry of Communication. The plenary session saw the presentation of final reports on the seminars by the chairman of the different seminars and all were impressed by the frank and forthright way these reports were drawn up and presented. Reports and resolutions are also included as part of this report.

The most important outcome of the convention was the formation of a "Federation of Radio Amateur Societies and Clubs in India." A committee with Comdnt. Gen. Uday Chinnubhai, VU2UD as chairman and M. V. Chauhan, VU2MV; T.P. Sheth, VU2TP; B. S. Dutt, VU2AJ; G. V. Sulu, VU2GV; D. W. Dalrymple, VY2OLK; Maj. J. K. Deshpande, VU2ED; K. G. Girimaji, VU2GX; Saad Ali, VU2ST; T. K. Rao, VU2TO; P. S. Kochhar, VU2QH; V. J. Bhatt, VU2RK; R. M. Pandya, VU2MQ, (convenor) as committee members, will go into action immediately to bring all amateur radio interests in India under one banner and achieve the program drawn up by the convention.

The chief guest, Shri N. C. Srivatsava, was impressed by the large gathering of the amateur radio fraternity present at the convention and the results achieved. He was very happy with the formation of a federation of all Indian amateur radio interests and complimented the convention for taking the right step. He blessed the new federation and assured his department's fullest co-operation.

Shri N. C. Srivatsava told the gathering that the XIIth Plenary Assembly of the International Radio Consultative Committee of the International Telecommunication Union will meet in Delhi from January 21st to February 11, 1970, on the invitation of the Government of India. The delegates will include many amateur radio enthusiasts and it would be appropriate to take advantage of their presence to popularise this scientific hobby.

He invited the organisers of the convention to take this opportunity to arrange a get-together to meet their counterparts from abroad at Delhi during the C.C.I.R. session. He invited Indian amateurs to participate in a proposed exhibition of radio equipment by displaying and demonstrating their equipment, to create interest in the student community as well as manufacturers of equipment.

Thus concluded this most memorable convention, the like of which has never been held in India. Momentous decisions were taken which we are confident will pave the way to the healthy growth of amateur radio and open up new horizons for achievement of ideals and aspirations.



Our amateur correspondent Pierce Healy, VK2APQ, with a group of delegates to the First All India Amateur Radio Convention. Some of the lady delegates are licensed amateurs.

Prizes and awards to exhibitors and delegates for various achievements in the respective fields were also presented by Shri N. C. Srivatsava. A detailed report on this aspect is being prepared. The proceedings were concluded with a very illuminating speech by Shri Saad Ali, VU2ST, who made a very excellent job of rounding up the convention activities. He paid tribute to all who made the convention such a grand success, surpassing the most optimistic expectations. He attributed this success mainly to the delegates who came to attend the convention in such a large number and at such great inconvenience to themselves. Undoubtedly amateur radio will thrive on the results achieved and reach new heights in time to come.

Amateur Radio in India

The first Seminar was called to order at 0930 hours on December 28, 1969, to discuss the papers submitted on the subject of "Amateur Radio in India," Lt.-Col. Dady S. Major, VU2MD, was in the chair. Mr V. P. Asar, VU2VA, was co-chairman and Mr Saad Ali, VU2ST, the principal speaker.

The seminar was well attended and the discussions were lively. It was brought out that as against a total of approximately 450,000 radio amateurs in the world we have only 500 in India which gives an average of only one per million population as against the world average of 1,200 per million.

Trying to fathom this situation we find that in pursuit of the hobby the Indian amateur faces problems on many fronts. Not only the common man but many people from educated classes, even in the technological field, have never heard of amateur radio. Many of those who know something about it consider it to be a luxury, forgetting its creative and scientific aspect and of the few who do recognise this only a few aspire to become radio amateurs because of the following difficulties they have to face:

- (a) Inordinate delay in the issue of licences; in certain cases several months after appearing for Government examination.
- (b) Non-availability of equipment and components. He has somehow managed to make do with the World War II disposals so far. Even that source is now drying up if not actually exhausted. In-

stead of any prospect of improvement on this front it is found that the problem is becoming more and more acute, seriously hampering the growth of this hobby in the country. Due to the low level of income it is all the more necessary that the Indian amateur should get the correct equipment and components for the money spent.

(c) Lack of facilities for training prospective amateurs.

(d) Lack of adequate publicity.

(e) the rigidity of Government regulations is inhibiting the growth of amateur radio in our country. In spite of showing our usefulness to the nation at the time of the P and T strike, we have not been given any worthwhile opportunity to prove our usefulness in times of emergencies. A little more trust and confidence reposed in us, and further necessary relaxation of regulations by the Government, we assure will be more than repaid by the amateur in his service to the nation.

(f) The amateur in India, as anywhere else in the world plays a vital role in the field of advancement of wireless communication technology. The self-generating fraternity, without taxing the Government or society, creates technical skill of high order. It deserves encouragement by all concerned.

It was resolved that the following

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points be taken up for further consideration.

(a) Publicise our hobby in schools, colleges and technical institutions with practical demonstrations.

(b) Approach different user departments, through the Wireless Planning Co-ordination Department of the Ministry of Communications, for the release of surplus equipment to amateurs at reasonable cost.

(c) Approach manufacturers with the request to produce equipment and components for amateurs at reasonable cost.

(d) Request the Wireless Planning and Co-ordination Department to expedite the issue of amateur licences.

(e) Organise exhibitions and displays in different towns for the benefit of the general public.

(f) Organise clubs at different places where practicable for the training of prospective amateurs.

(g) Request Government for grant of import licences to amateur radio societies, clubs and individual amateurs to import essential requirements not available locally.

(h) Request the Wireless Planning Co-ordination Department to:

(I) Grant mobile licences.

(II) Freely allow amateur activities such as field days, hidden transmitter hunts, etc.

(III) Allow third-party traffic by radio amateurs in matters of domestic emergencies of the general public at large without any pecuniary gain to the amateur.

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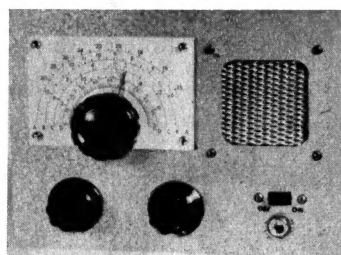
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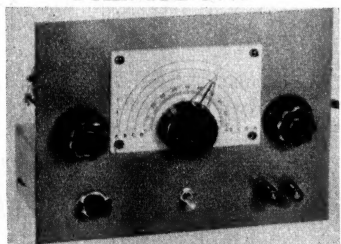
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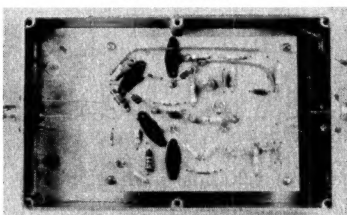
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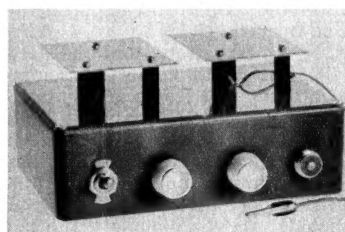
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